Energy Research and Development Division

FINAL REPORT

Biodico's Zero Net Energy Farm

Appendices A-R

California Energy Commission

Gavin Newsom, Governor

April 2019 | CEC-500-2019-045AP-A-R

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APPENDIX A:
Tractor Port

ZNEF is intended as a demonstration site for a variety of different renewable energy technologies. Up to five types of solar technology will be demonstrated as part of ZNEF.

The underlying base map data for the PMA are from the National Renewable Energy Laboratory. Their PVwatts Calculator (http://pvwatts.nrel.gov/) indicates that the efficiency factor of the fixed roof mount solar panels tilted at 6° will be 17% (National Renewable Energy Laboratory, 2018). This system has been made agriculturally appropriate by enlarging the conventional car port solar design to accommodate agricultural equipment. These "Tractor Ports" are shown in the following drawing photos.

Figure 1: Borga Tractor Port

Borga agricultural storage structure in New Cuyama Valley, CA.

Photo by Borga 2017

A Request for Proposals was developed with this Master Community Design. Biodico and Red Rock Ranch[1] reviewed the bids received and decided to award the contract to Borga/Shorebreak Energy Developers. The design will be submitted as part of the building permit process with the Fresno County Planning Department.

Bird Mortality

Wind turbines can impact hawk and owl populations which are valuable for controlling rodents in orchards and vineyard (Kross, 2016). However, by combing a solar roof and ground level shielded wind turbines, this problem can be eliminated. The solar roof serves as a wind scoop

[1] "Red Rock Ranch" refers to itself and related entities held by John Diener and his family.

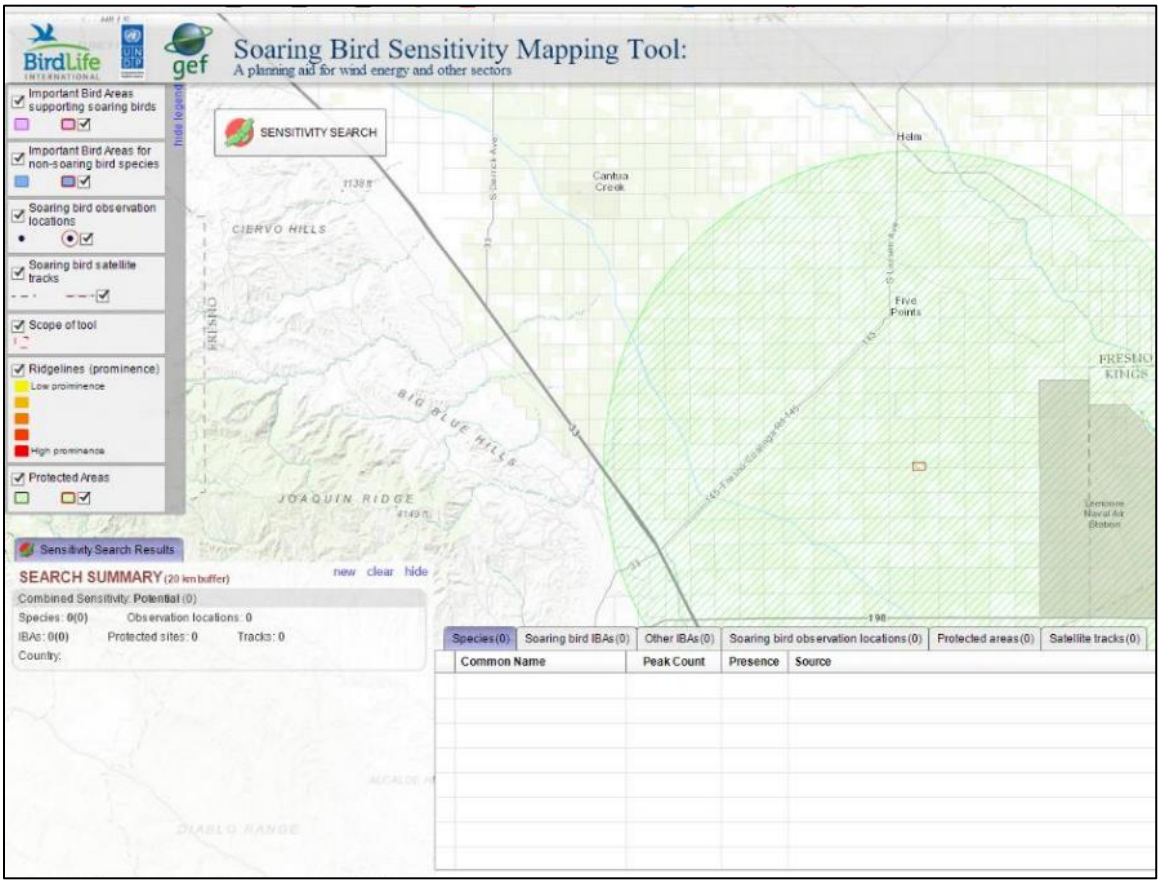
for low wind areas where the wind is predominantly from the northwest, as it is in the Central Valley.

Hundreds of thousands of birds and bats are killed by wind turbines in the US each year, including some protected species such as the golden eagle and the Indiana bat. That's only a small fraction of the hundreds of millions killed by buildings, pesticides, fossil-fuel power plants, and other human causes, but it's still worrying—especially as wind power is experiencing record growth (Drouin, 8 Ways Wind Power Companies Are Trying to Stop Killing Birds and Bats, 2014).

The industry is collaborating with wildlife researchers on promising technologies and approaches that are already being field-tested. Here are eight things the industry is trying or considering in an effort to reduce bird and bat mortality (Drouin, 8 Ways Wind Power Companies Are Trying to Stop Killing Birds and Bats, 2014).

1. **Smarter Siting:** The No. 1 way to prevent bird deaths is to do a better job choosing sites for wind energy development, said raptor researcher Richard Gerhardt: "It's an issue of where you put the turbines." Biodico has determined that the proposed site is not with a migratory zone by referring to the Soaring Bird Sensitivity Mapping Tool (ESRI, 2018).

Figure 2: Soaring Bird Sensitivity Mapping Tool

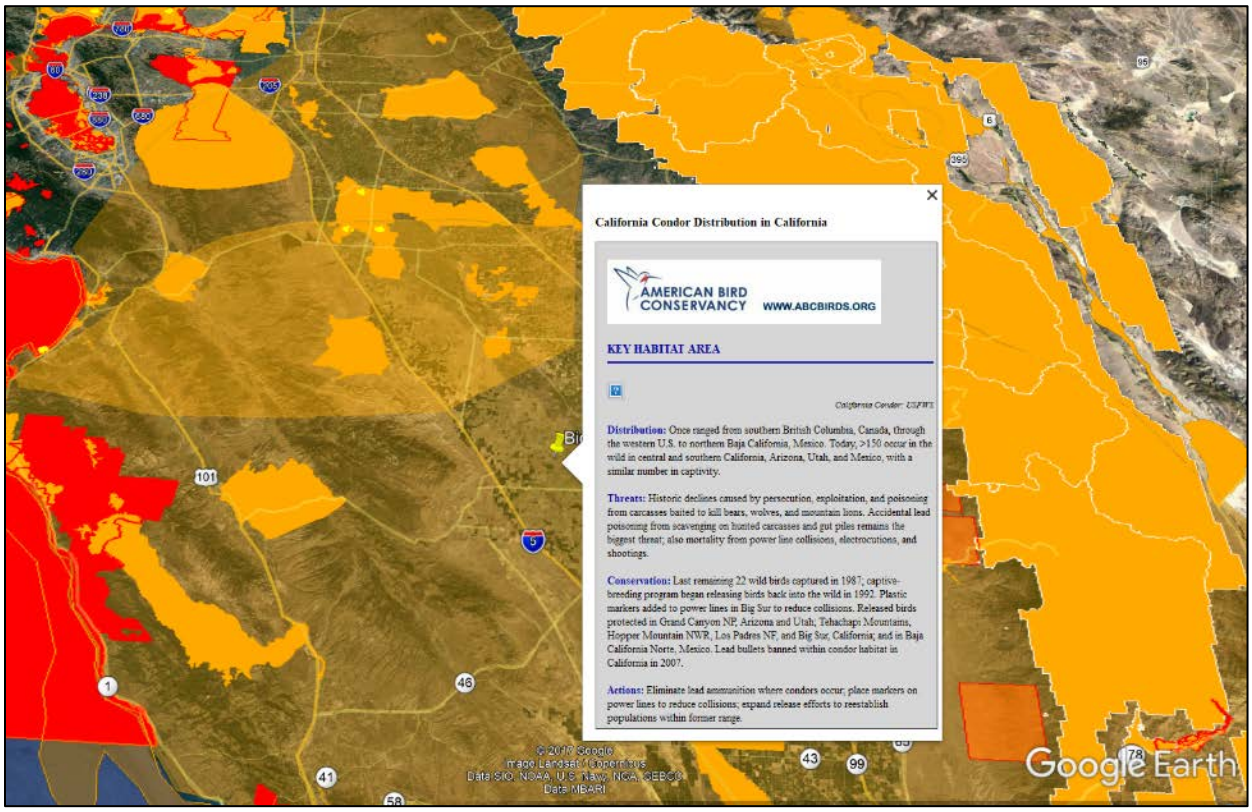


This figure showing the migratory pathways and sensitive areas for soaring birds.

Courtesy of ESRI and Birdlife International, 2017

The Wind Risk Assessment Map (American Bird Conservancy, 2018) is much more detailed for California. It is a series of KMZ overlays on Google Earth and shows that the ZNEF site was once California Condor habitat. Since California Condors are an endangered species, they are fitted with GPS tracking monitors which may be monitored to see if they start ranging into the ZNEF site.

Figure 3: Wind Risk Assessment Map



This map shows that the ZNEF site was once habitat for the California Condor.

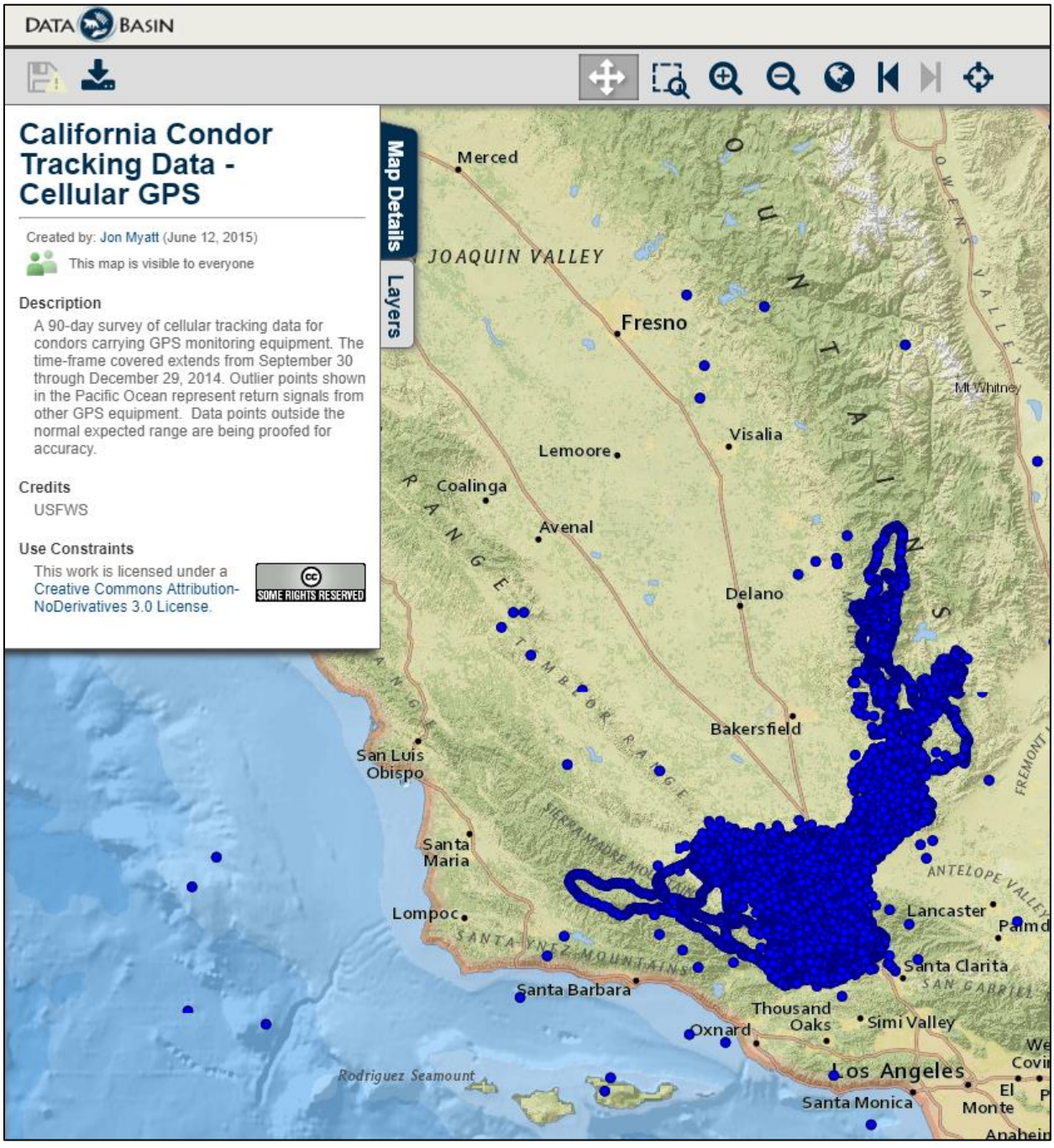
American Bird Conservancy, 2017

2. Radar: The industry is also turning to radar technology that could detect when eagles and other birds are approaching. Turbines could be slowed or shut down when the radar, along with employees monitoring the horizon, determine birds are within a certain zone. This approach is too costly for small wind turbines.

3. GPS Tracking: Thus far there have been no reported California condor deaths caused by wind turbines. Many of the 230 California condors flying in the wild are fitted with cellular GPS transmitters, so Terra-Gen, one of the top wind developers in the country, uses a high-frequency receiver to track the condors near its California facilities. Data Basin has posted 90-day California Condor Tracking Data that shows the range of the Condors, which at now point was closer than 40 miles to the ZNEF site. Biodico will check into the cost and availability of

Condor GPS tracking devices. The other birds frequenting the ZNEF site are not fitted with GPS tracking devices.

Figure 4: California Condor Tracking Data



90-day tracking data for the California Condor.

Jon Myatt, US Fish and Wildlife Service

4. Ultrasonic Acoustics: Most birds killed by wind turbines die because they get hit by spinning blades. Many bats seem to die for a different, even gorier reason: the lower wind pressure near the blades causes their lungs to explode. Because birds and bats react differently

to turbines, scientists are pursuing different methods to protect them. Bat Conservation International has been collaborating with Deaton Engineering to design ultrasonic "boom boxes" that emit continuous high-frequency sounds, from 10 kHz to 100 kHz, intended to confuse bats' echolocation to the point that they avoid the area. Study results on this kind of technology have been largely inconclusive so far (Deaton Engineering, 2018). This approach is too costly and the results are speculative for use at the ZNEF site.

5. Leaving Turbines Off: The second strategy that has been shown to help reduce bat deaths is waiting longer to turn on the turbines, until wind speeds are higher. According to the only published study on the subject, leaving the turbines dormant until wind speed reaches 5.5 meters per second reduced bat mortality by nearly 60 percent compared with normally operating turbines. The industry standard is to have blades start spinning when wind hits 3.5 to 4 meters per second. The question is whether this method is economically feasible. Small wind turbines do not have feathering propellers or automated vanes, so it is difficult to stop them.

6. Painting Turbines Different Colors: Another theory is that bats approach the turbines in pursuit of prey. A study conducted in England suggested that simply changing the color of wind turbines to hues less attractive to insects could reduce the number of bugs that congregate around the turbines, which could in turn reduce bat deaths. If there is bat mortality at the ZNEF site, this approach can be tried.

7. Designing New Turbine Shapes: Earlier designs were found to attract roosting birds, which would perch and nest inside the turbines' lattice-style structures, but newer designs discourage roosting. In addition, engineers are exploring completely new kinds of wind equipment that could potentially be less harmful to birds and bats than traditional turbines. They range from large kites that harness the wind to vertical axis turbines. A jet-engine-inspired design, called the FloDesign turbine, marks a distinct departure from traditional turbine design, with blades encased in a larger structure. Because it would be more visible, Allison believes it could pose less of a threat to birds. This is the approach that Biodico has taken to reducing bird mortality: ground level turbines are out of the flight patch of most birds and the blades are shielded by the equivalent of a chain link fence.

8. Strike detection: If a turbine could recognize when it has been hit by a bird, it could potentially slow itself down or shut off to minimize the risk to other birds in the area. Small wind turbines do not have feathering propellers or automated vanes, so it is difficult to stop them.

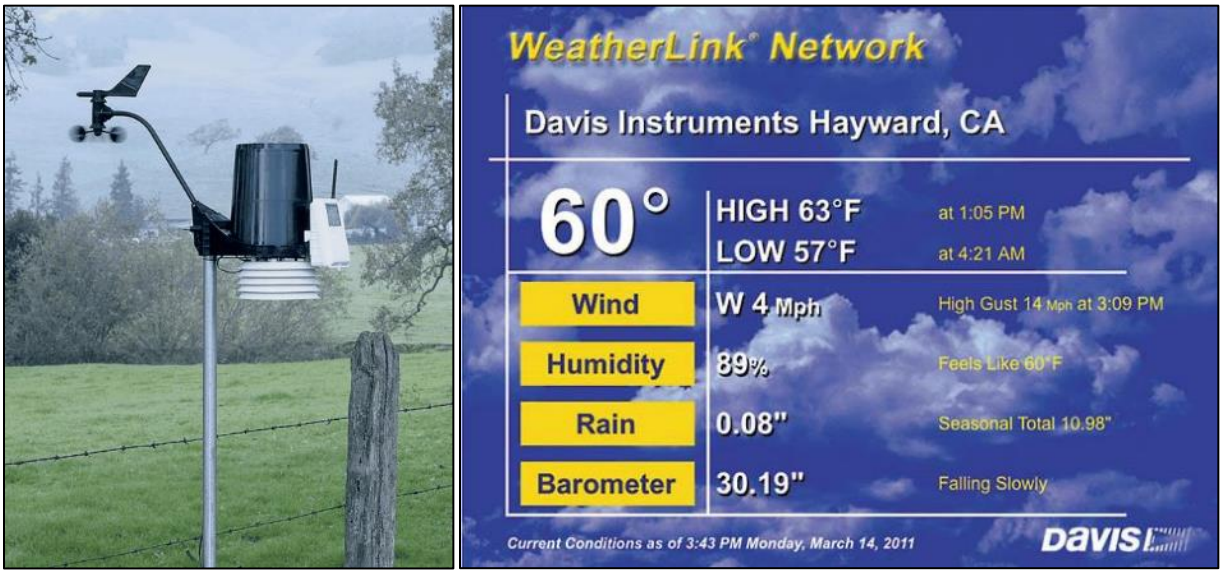
Conclusion: The best ways to avoid bird strikes for agricultural interests is to (1) not site turbines in migratory pathways, (2) check into the cost and availability of Condor GPS tracking monitors, (3) potentially paint turbine blades different colors if bat mortality becomes a problem, and (4) shield the turbine blades so that birds and bats cannot be struck.

Wind Study

A wind (and solar) study is being conducted at the site of the proposed installation using a solar powered WiFi enabled Davis, Vantage Pro2 Plus weather station

(http://www.davis.com/Assets/MoreInfo/86403-13Specs.pdf) and the Davis 6555 WeatherLink IP Software (http://www.davis.com/Product/Davis_6555_WeatherLink_IP_Software_for_Vantage_Vue_and_Vantage_Pro2/WO-99800-65), which allows data to be archived and uploaded to Weather Underground and accessed by the public.

Figure 5: Davis Weather Station and Software



The Davis weather station and software allow wind direction and speed to be archived and uploaded to the internet.

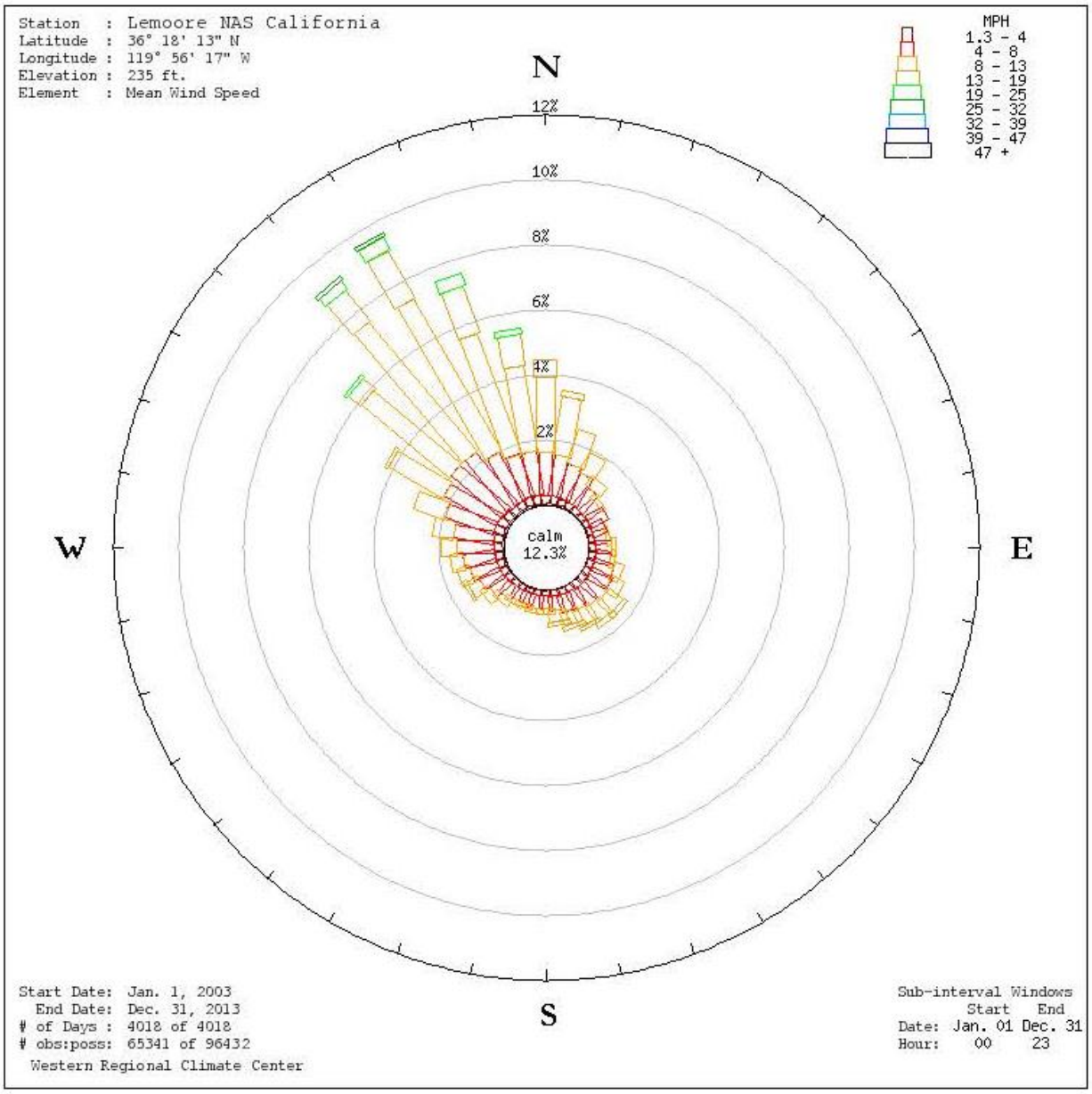
Pictures courtesy of Davis Instruments, Hayward, CA 2017

Data from the Western Regional Climate Center at the Desert Research Institute in Reno, NV gives the average wind speed and direction over a ten-year period for Naval Air Station Lemoore[2] as 7.6 miles per hour and from 325° (north, northwest). A wind rose, and the supporting data is shown in

2 Naval Air Station Lemoore is the closest reporting weather station to the ZNEF Site with historic wind data going back to 1961. The weather station is 5.5 miles from the ZNEF site and the wind readings were taken from 9′ above ground level.

Figure 6: Wind Rose for Lemoore Naval Air Station.

Figure 6: Wind Rose for Lemoore Naval Air Station



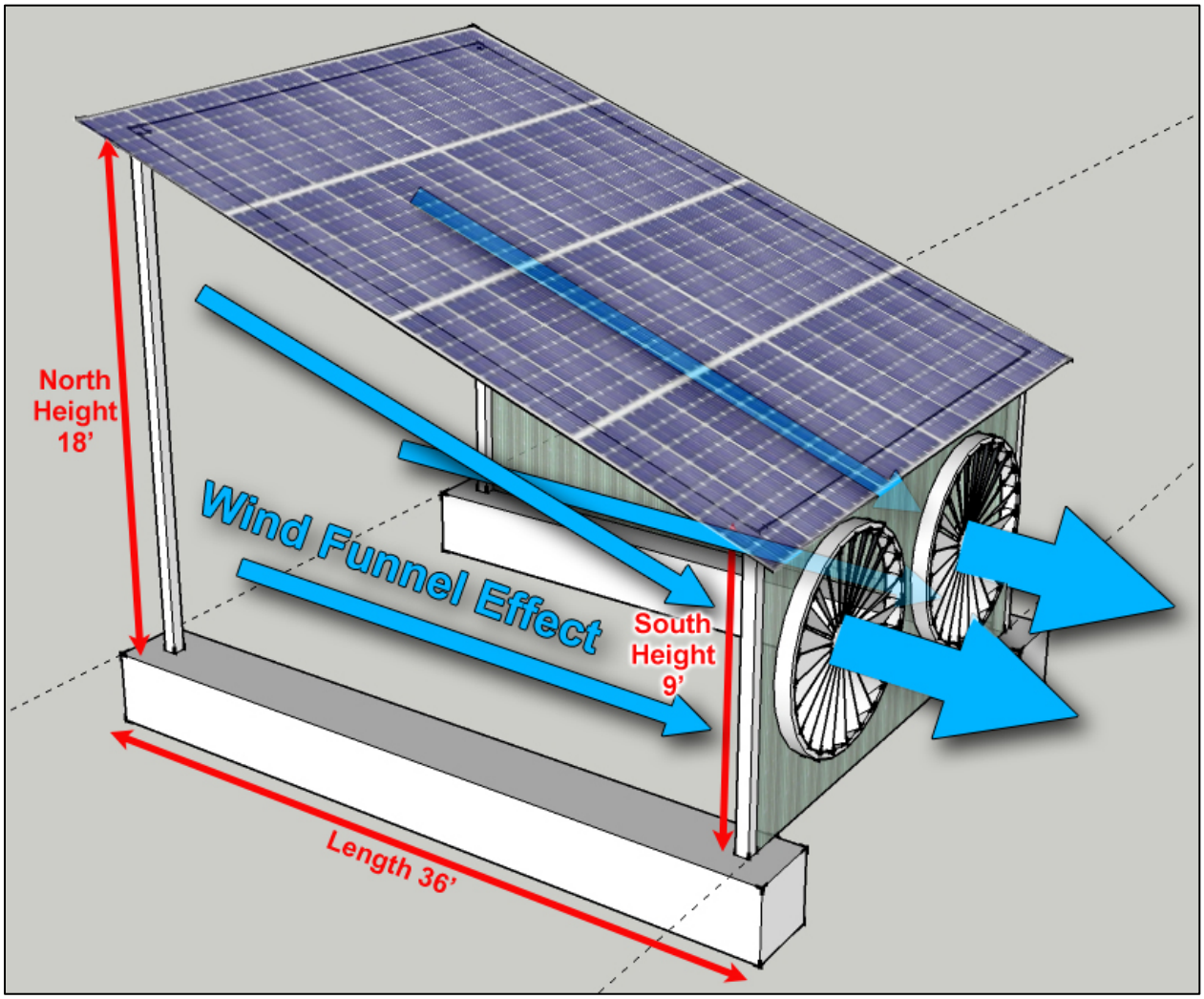
This wind rose shows to predominant wind is coming from the north-northwest.

Courtesy of the Western Regional Climate Center

Engineering

Engineering for the solar and wind Tractor Port potential is being conducted by Kyle Lawrence, PE at the US Navy, Chelsea Teall, PE (formerly a design engineer for SunPower) and Jill Brigham, aeronautical engineer at NASA Houston, and currently at UC Davis. A summary of the drawings and engineering data is given below.

Figure 7: 3D Rendering of the Tractor Port



This 3D rendering shows the dimensions and the wind scoop effect of the Tractor Port.

Graphic ©2017 Biodico, Inc.

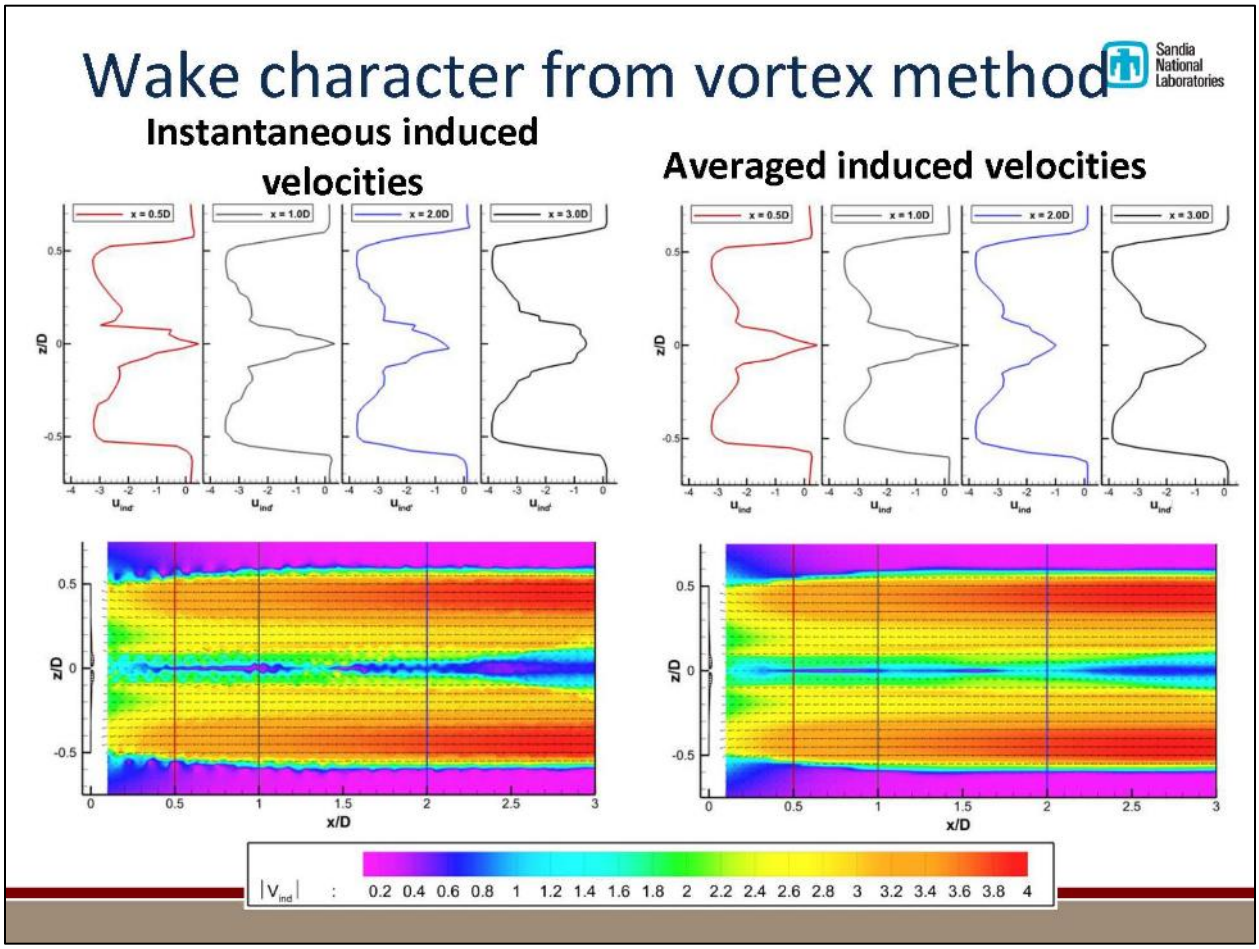
The dimensions of the Tractor Port are 18' north height, 9' south height. 36' long and 72' wide. The actual plans for the Tractor Port are shown in the figure above.

The Tractor Port south wall will have twelve (12) 2,000-watt wind turbines with a cut in speed of 6 mph and a power curve as shown in *Figure 11: Missouri Wind Turbine Power Curve.* The vendor for the ground level shielded wind turbines is Missouri Wind and Solar.

Turbine Induced Turbulence

The spinning blades of the turbine create induced turbulence, which if obstructed, can induce drag. *Figure 8: Wake Character from Vortex Method* illustrates the results of a wind turbulence study conducted at Sandia National Laboratory. The conclusion is that the free space surrounding the wind turbine should ideally be 50% of the length of the turbine blade and extend downwind for at least 100% of the length of the blade.

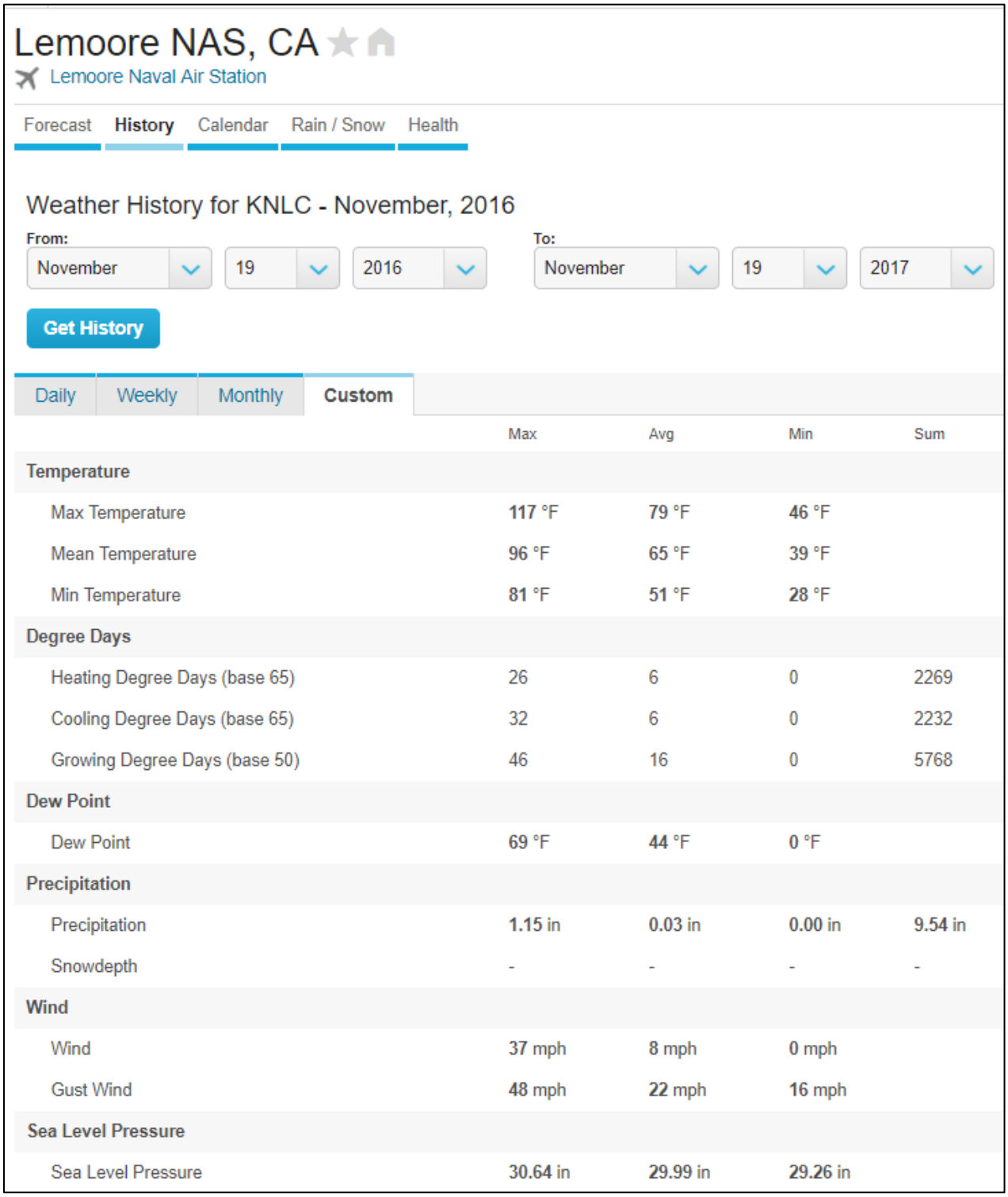
Figure 8: Wake Character from Vortex Method



Free space surrounding the turbine can impact drag.

Maniaci, David, Sandia National Laboratory, Wakes and Rotors: The National Rotor Testbed,2014, page 24.

Figure 9: Lemoore Naval Air Station Weather



Lemoore NAS, CA

Lemoore Naval Air Station

Forecast | History | Calendar | Rain / Snow | Health

Weather History for KNLC - November, 2016

From: November 19 2016 To: November 19 2017

Get History

Daily | Weekly | Monthly | Custom

	Max	Avg	Min	Sum
Temperature				
Max Temperature	117 °F	79 °F	46 °F	
Mean Temperature	96 °F	65 °F	39 °F	
Min Temperature	81 °F	51 °F	28 °F	
Degree Days				
Heating Degree Days (base 65)	26	6	0	2269
Cooling Degree Days (base 65)	32	6	0	2232
Growing Degree Days (base 50)	46	16	0	5768
Dew Point				
Dew Point	69 °F	44 °F	0 °F	
Precipitation				
Precipitation	1.15 in	0.03 in	0.00 in	9.54 in
Snowdepth	-	-	-	-
Wind				
Wind	37 mph	8 mph	0 mph	
Gust Wind	48 mph	22 mph	16 mph	
Sea Level Pressure				
Sea Level Pressure	30.64 in	29.99 in	29.26 in	

The average wind speed at Lemoore NAS for the year ending November 19, 2017 was 8 mph.

Weather Underground, November 19, 2017, https://www.wunderground.com/history/airport/KNLC/2017/11/19/DailyHistory.html

Figure 10: Missouri 2,000-Watt Wind Turbine

Description | Specification | Reviews (0)

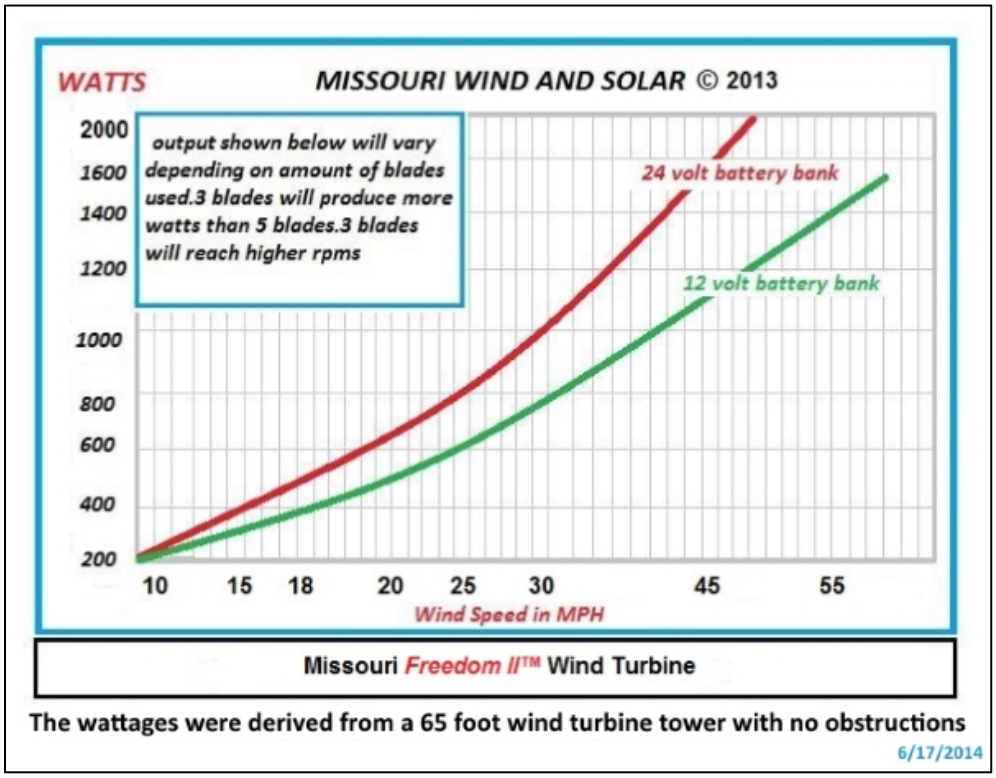
Wind Turbine Specifics

Available Voltage	12/24 Volts, 24/48 Volts, 48/96 Volts
Available Wattage	2000 Watts
Motor Type	Freedom II PMG
Blade Series	Raptor Generation 4
Blade Length	29 Inches / 73.66 Centimeters
Blade Width (at base)	6 Inches / 15.24 Centimeters
Blade Width (at tip)	1 1/8 Inches/ 28.575 Millimeters
Blade Material	Carbon Fiber
Blade Quantity	11 Blades
Assembled Diameter	60.2 Inches / 1.53 Meters
Special Coating	Zinc Plated, Hot Dipped Galvanized

Missouri 2,000-Watt Wind Turbine technical specifications.

2017 Missouri Wind

Figure 11: Missouri Wind Turbine Power Curve



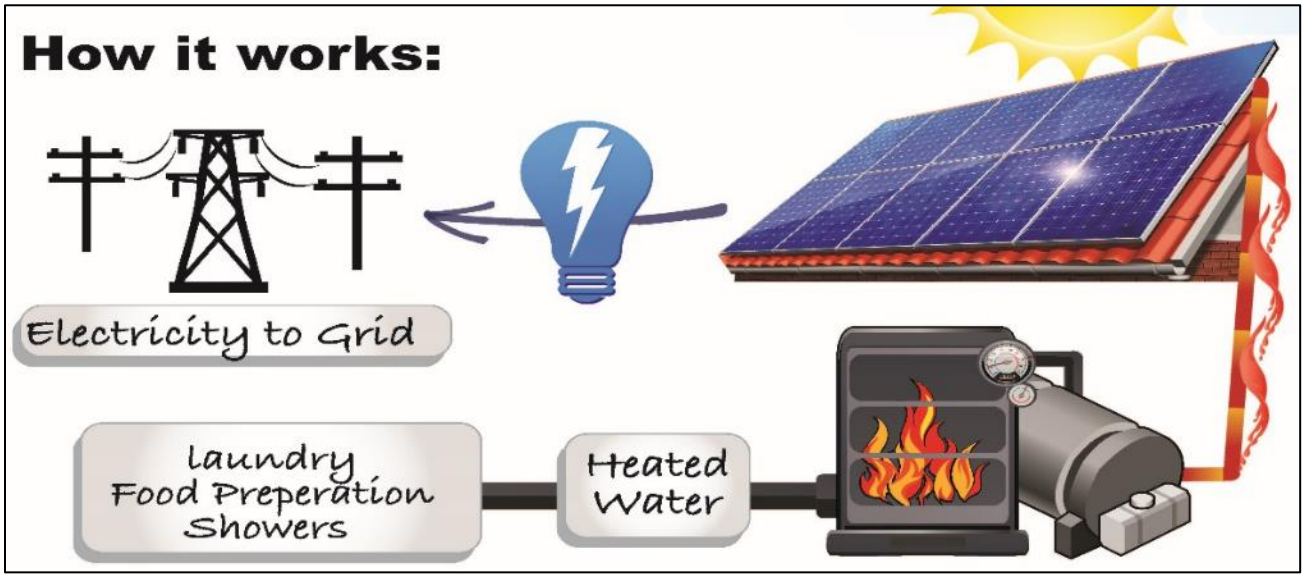
Missouri Wind Turbine Power Curve.

2017 Missouri Wind

APPENDIX B:
CoolPV

CoolPV is a single solar panel which produces both heat and electricity. The parent company, Fafco, is located in Chico, CA. The following diagram illustrates the CoolPV panel.

Figure 12: CoolPV Diagram



FAFCO CoolPV functional diagram.

2017 Fafco

The CoolPV panels will be mounted to an existing single axis 20° tilt system with a capacity for 24 panels, as shown in the photo below. The electrical generating efficiency of the system as determined by PVwatts Calculator is 22.4% and has a design capacity of 6.6 kW electric and 24 kW of heat.

Figure 13: CoolPV Location

Location of CoolPV awning is shown in red.

2017 Biodico

APPENDIX C:
Giraffe 2.0

Figure 14: What is the Giraffe 2.0?

The Giraffe 2.0 by InnoVentum is a combined carport and charging station harvesting green energy from the wind and sun to power your e-vehicle.

The Giraffe 2.0 is made of renewable (wood) and recycled (metal) materials bringing green power stations to the next level of sustainability. The trees used for the structure have absorbed several tons of CO_2 from the atmosphere before their wood takes the unique shape of a Giraffe – all this carbon dioxide is preserved within the structure for decades, making a positive contribution to the climate.

To give you flexibility, we combine the Giraffe 2.0 power station with the EV-charger you prefer, making it possible to charge your e-car in just a couple of hours. If you do not yet have an e-car, or a plug-in hybrid, you can of course connect the Giraffe 2.0 directly to the utility grid and power your house or install an off-grid Giraffe 2.0 where grid is not available.

On average, the Giraffe 2.0 gives you energy for more than a 225 km e-drive per day – and in a year it produces enough energy for you to drive twice around the world!

Being a hybrid energy station, the Giraffe 2.0 offers two distinct advantages:

- Continuity of power production: complementary wind and solar technologies provide energy day and night, summer and winter;
- Power density for space efficiency: the power production per square meter of footprint is doubled compared to solutions of the same size relying only on sun, or only on wind.

Moreover, use of wood ensures silence of operation thanks to the fibers in the timber structure absorbing vibrations and noise.

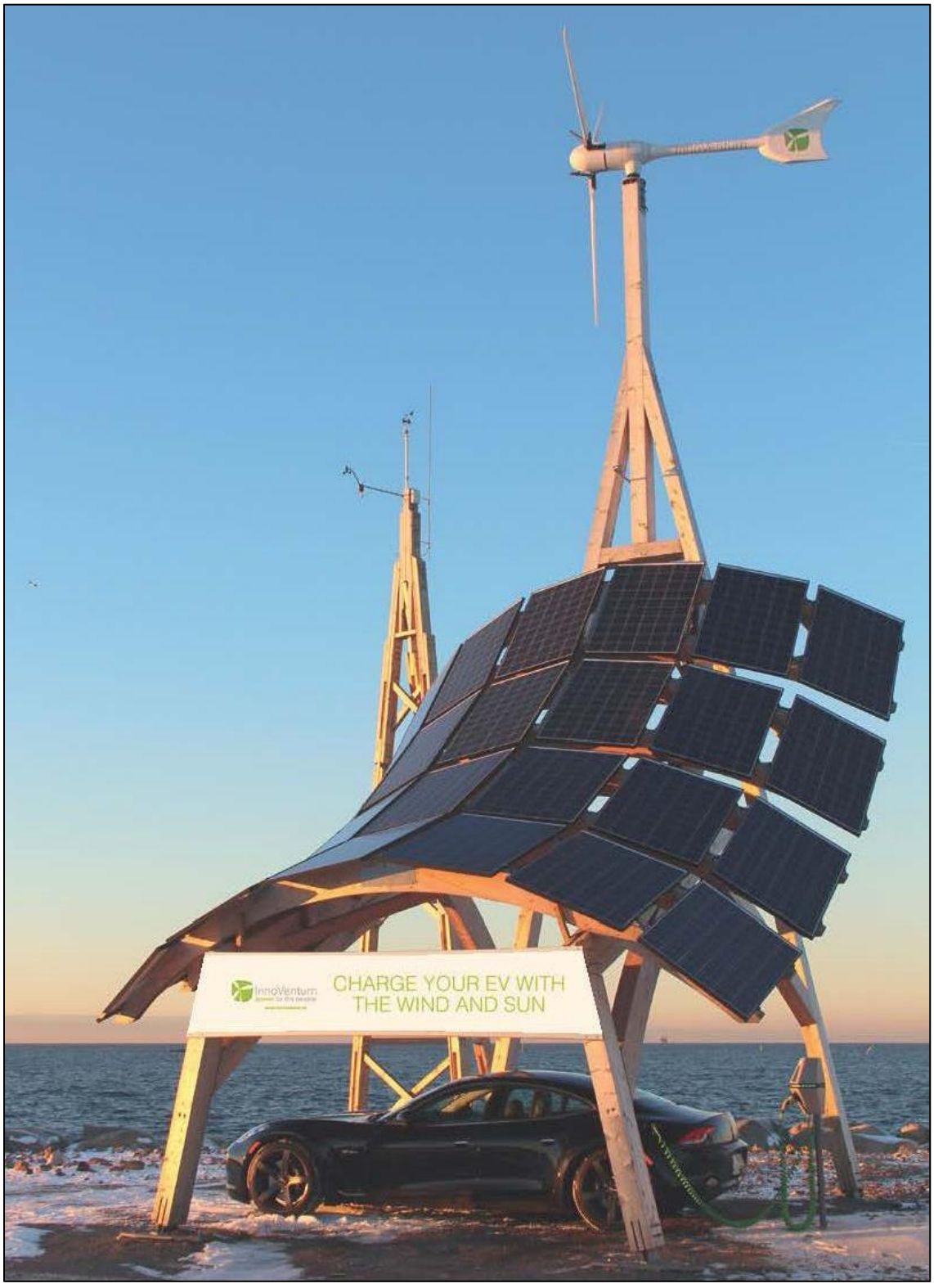
Finally, the unique design of the Giraffe 2.0 does not leave anyone indifferent – our installations prove to attract a lot of attention from children and adults alike.

With the Giraffe 2.0 you make an important step into the future – where focus on renewable materials and energy sources puts a natural end to CO_2 emissions from careless use of our Planet's mineral resources and fossil fuels.

Description of the Giraffe 2.0

2018 Innoventum

Figure 15: Innoventum Giraffe 2.0



Innoventum Giraffe 2.0 combined solar, wind and EV charging station

2018 Innoventum

Figure 16: Giraffe 2.0 Technical Specifications

Giraffe 2.0 – Technical Specifications

Parking space	Two cars
Annual energy output (at 6 m/s wind)	13 850 kWh
EV mileage per year	45 000 km x 2 cars
Footprint	24.6 m²
Dimensions (width x length x height)	4.1 m x 6.0 m x 12.0 m
Energy Density (kWh / m² footprint)	560 kWh / m²

For complete information on technical specifications & benefits of our solutions, please visit our website: www.innoventum.se

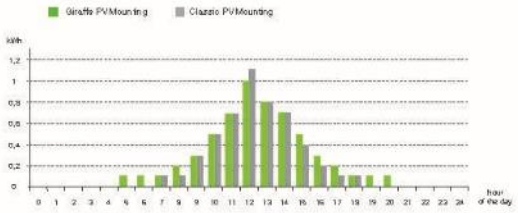
Charging Stations – Examples

Giraffe 2.0 is compatible with any EV-charger standard, please send us an inquiry to info@innoventum.se for more information.

		SEMI-FAST CHARGING		FAST CHARGING
Mounting/positioning		Wall- or pole-mounted		Stand-alone
Standards		AC type1 & 2		DC CCS & CHAdeMO; AC type 2
Maximum output		22 kW		50 kW
Rated voltage		230 / 400 VAC		400 VAC
Charging time 24 kWh (e.g., Nissan Leaf)		50% over 30-90 minutes		50% over 15 minutes

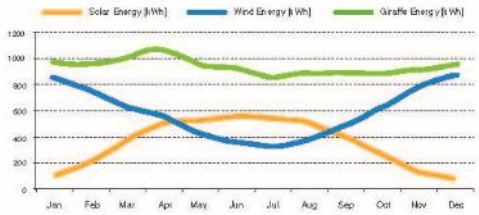
Extended Energy Production

Thanks to the intelligent (carefully calculated) positioning of PV panels the Giraffe 2.0 starts producing solar energy 2 hours earlier and stops 2 hours later than a classic PV mounting – avoiding peak production at midday and yielding energy over a longer period of time.



Flat Energy Curve

Wind and solar power harvesting technologies are highly complementary (day – night, summer – winter) providing green energy day and night, all year round. Therefore, you can rely on a flat energy curve.



The graphs are merely illustrations and do not reflect the actual energy production at a particular site.

InnoVentum
power to the people

Please feel free to contact us: Tel. +46 40 30 59 66, info@innoventum.se
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Giraffe 2.0 technical specifications

APPENDIX D:
SmartFlowers

SmartFlower is a dual axis tracking solar PV system that tracks, cleans and stows automatically and includes battery storage and vehicle charging. It has a capacity of 2.5 kW and is 25.1% efficient according to PVwatts Calculator.

Figure 17: SmartFlower Drawings

Drawing of dual axis SmartFlower

2018 SmartFlower

APPENDIX E:
Froling T4 Wood Chip Boiler

With the closing of biomass-to-energy facilities throughout California, farmers are having to openly burn wood waste from orchards and vineyards for the first time in nearly 20 years. This has a severe negative impact on air quality. Small farm-sized wood chip gasifiers are clean and can eliminate this problem, while generating heat and power for farmers. The unit being specified for the ZNEF is a Froling T4-150 capable of producing 150 kWh of heat.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) requires design review for wood chip boilers. Permits are being process now. The emission data is hown below and clearly falls within the Best Available Control Technology limits.

Table 1: Froling Emissions

Kesseltype T4-150, Brennstoff Holzhackgut, Mittelwerte gemäß ÖNORM EN 303-5:2012

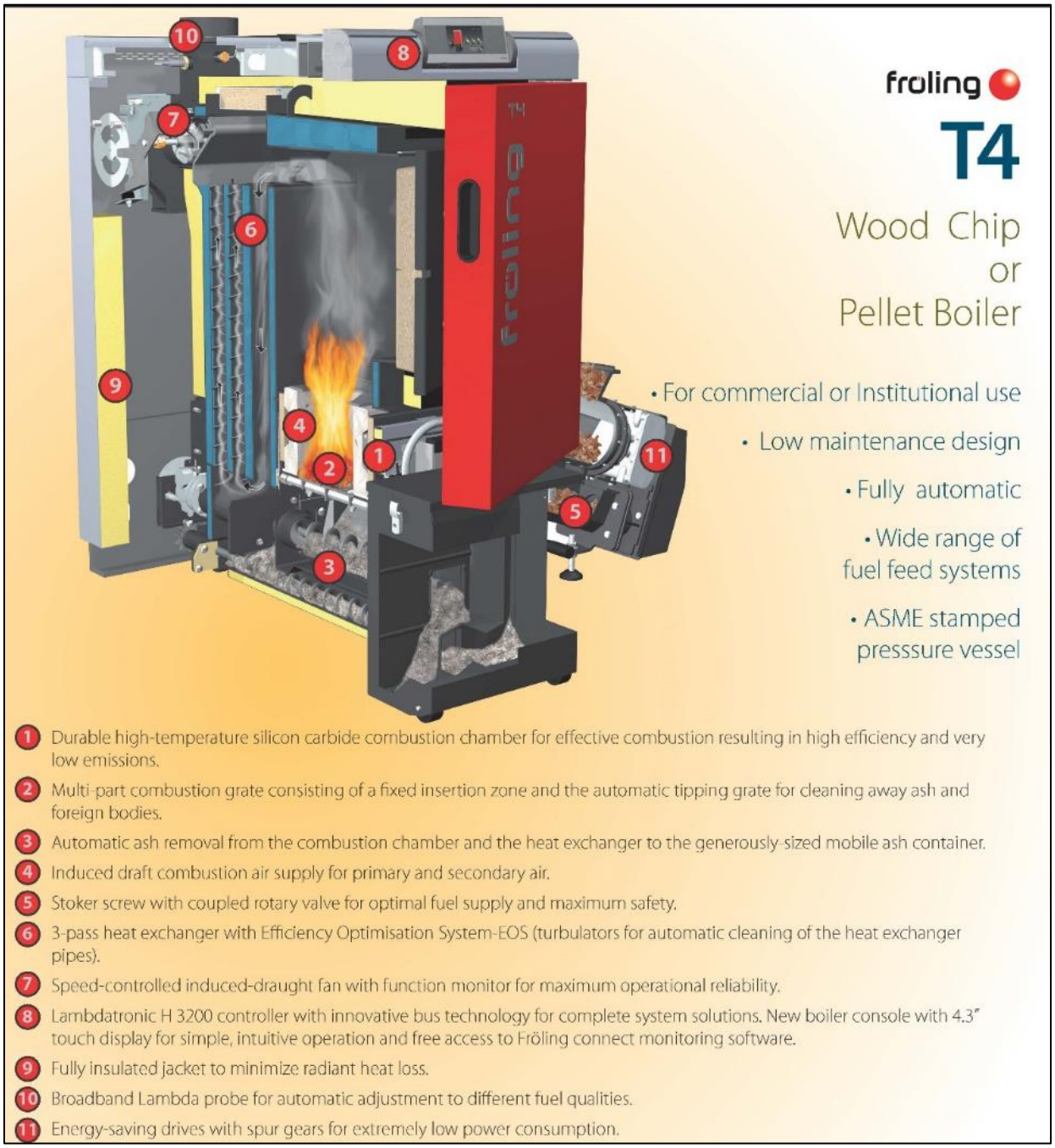
Parameter	Nennlast	Teillast
Datum der Messungen	13.08.2013	05.08.2013
Messzeit (von – bis)	13:00-19:00 Uhr	12:17-18:17 Uhr
Prüfdauer (h)	6,0	6,0
Nutzbar abgegebene Wärmeleistung (kW)	141,6	37,5
Sauerstoffkonzentration (% d. Vol.)	6,16	8,62
Kohlenstoffmonoxidemission (CO)		
bei ist O_2 (mg/m^3)	11	38
bez. auf 10 % O_2 (mg/m^3)	8	34
bez. auf 11 % O_2 (mg/m^3)	7	31
bez. auf 13 % O_2 (mg/m^3)	6	25
bez. auf den Energieinhalt (mg/MJ)	4	17
Stickstoffoxidemission (NOx)		
bei ist O_2 (mg/m^3)	174	177
bez. auf 10 % O_2 (mg/m^3)	129	157
bez. auf 11 % O_2 (mg/m^3)	117	143
bez. auf 13 % O_2 (mg/m^3)	94	114
bez. auf den Energieinhalt (mg/MJ)	64	78
Emission gasförmiger organischer Stoffe (OGC)		
bei ist O_2 (mg/m^3)	< 3	< 3
bez. auf 10 % O_2 (mg/m^3)	< 2	< 2
bez. auf 11 % O_2 (mg/m^3)	< 2	< 2
bez. auf 13 % O_2 (mg/m^3)	< 1	< 2
bez. auf den Energieinhalt (mg/MJ)	< 1	< 1

Froling T4-150 Woodchip Gasifier	
Specifications	
512,000	btu per hour
948	btu per MJ
540	MJ per hour
Emmissions	
64	NOx mg/MJ
1	VOC mg/MJ
65	Total mg/MJ
35,112	mg/hour
453,492	mg per lb
0.08	lbs/hour
SJVAPCD Rule 4352 sec. 4.0 Exemption	
10	tons per year
2.28	lbs/hour standard
2201 New Source Review	
2	lbs/day standard
1.86	lbs/day actual

Emissions data for Froling T4-150

2017 Froling

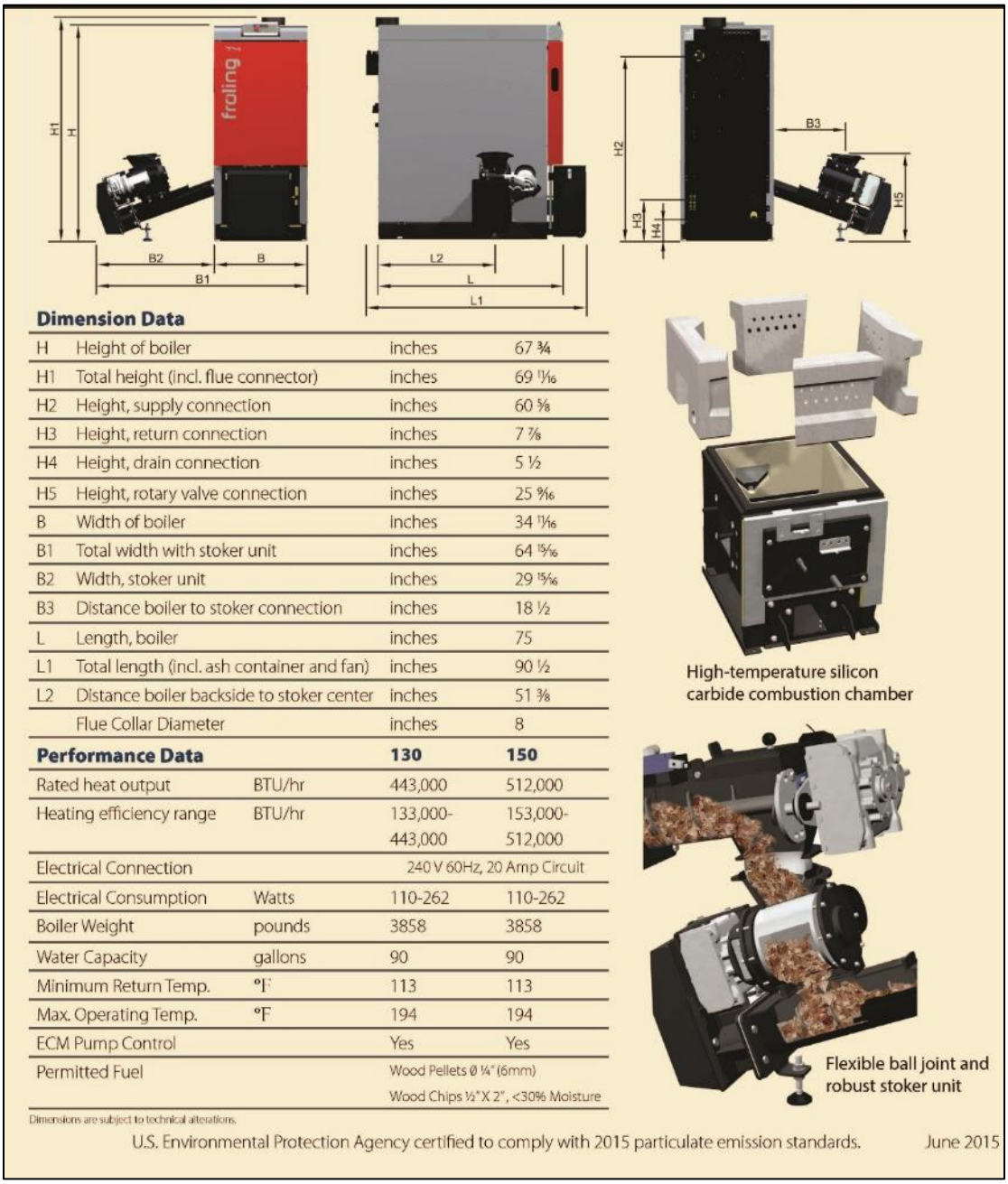
Figure 18: Froling Cross Section Drawing



Cutaway drawing of Froling wood chip boiler

2015 Froling

Figure 19: Froling Technical Specifications



Dimension Data

H	Height of boiler	inches	67 ¾
H1	Total height (incl. flue connector)	inches	69 1/16
H2	Height, supply connection	inches	60 ⅝
H3	Height, return connection	inches	7 ⅞
H4	Height, drain connection	inches	5 ½
H5	Height, rotary valve connection	inches	25 9/16
B	Width of boiler	inches	34 1/16
B1	Total width with stoker unit	inches	64 15/16
B2	Width, stoker unit	inches	29 15/16
B3	Distance boiler to stoker connection	inches	18 ½
L	Length, boiler	inches	75
L1	Total length (incl. ash container and fan)	inches	90 ½
L2	Distance boiler backside to stoker center	inches	51 ⅜
	Flue Collar Diameter	inches	8

Performance Data		**130**	**150**
Rated heat output	BTU/hr	443,000	512,000
Heating efficiency range	BTU/hr	133,000-443,000	153,000-512,000
Electrical Connection		240 V 60Hz, 20 Amp Circuit	
Electrical Consumption	Watts	110-262	110-262
Boiler Weight	pounds	3858	3858
Water Capacity	gallons	90	90
Minimum Return Temp.	°F	113	113
Max. Operating Temp.	°F	194	194
ECM Pump Control		Yes	Yes
Permitted Fuel		Wood Pellets Ø ¼" (6mm) Wood Chips ½" X 2", <30% Moisture	

Dimensions are subject to technical alterations.

U.S. Environmental Protection Agency certified to comply with 2015 particulate emission standards. June 2015

Froling technical specifications.

2015 Froling

APPENDIX F:
Entrade E3-E4 Gasifier

Figure 20: Entrade E-4 Photograph

Photograph of Entrade wood pellet CHP gasifier

2017 Entrade

Figure 21: Entrade E4 Technical Specification

Technical specifications
E4 50 kW Mobile Power Unit

Operating mode:	Downdraft fixed-bed gasifier
Type:	1 x E4 System

Equipment performance

Nominal power output:	50 kWel
Nominal heat output:	120 kWth
Total efficiency:	86%
Electrical efficiency:	25%
Thermal efficiency:	61%
Temperature of heat output:	90°C / 60°C
Electrical Output:	400 V / 50 Hz
Operating hours:	8000 h/a

Emissions

Sound:	60 dB(A)
Ash remaining approx:	0.3 - 0.4 kg/h

Feedstock and utilities

Feedstock:	Din EN Plus 6mm A1 or certified E-Fuel biomass waste pellets
Feedstock Consumption:	ca. 44 - 46 kg/h
Power:	3 Phase, 80 Amps
Cooling water:	Antifreeze MITAN Alpine c11 (50 Vol-% recommended)
Motor oil:	Fuchs Titan Ganymet Ultra
Filter:	Jetfilter with engine exhaust

Producer gas

Gas Composition (Wood Gas):	CO 23% / CO_2 9% / H_2 19% / CH_4 1.8%
Average calorific value:	>5200 kJ/m^3
Temperature of syngas at reformer exit:	700°C to 800°C
Temperature of syngas after quenching:	80°C to 100°C
Temperature of syngas/air mixture:	40°C to 60°C

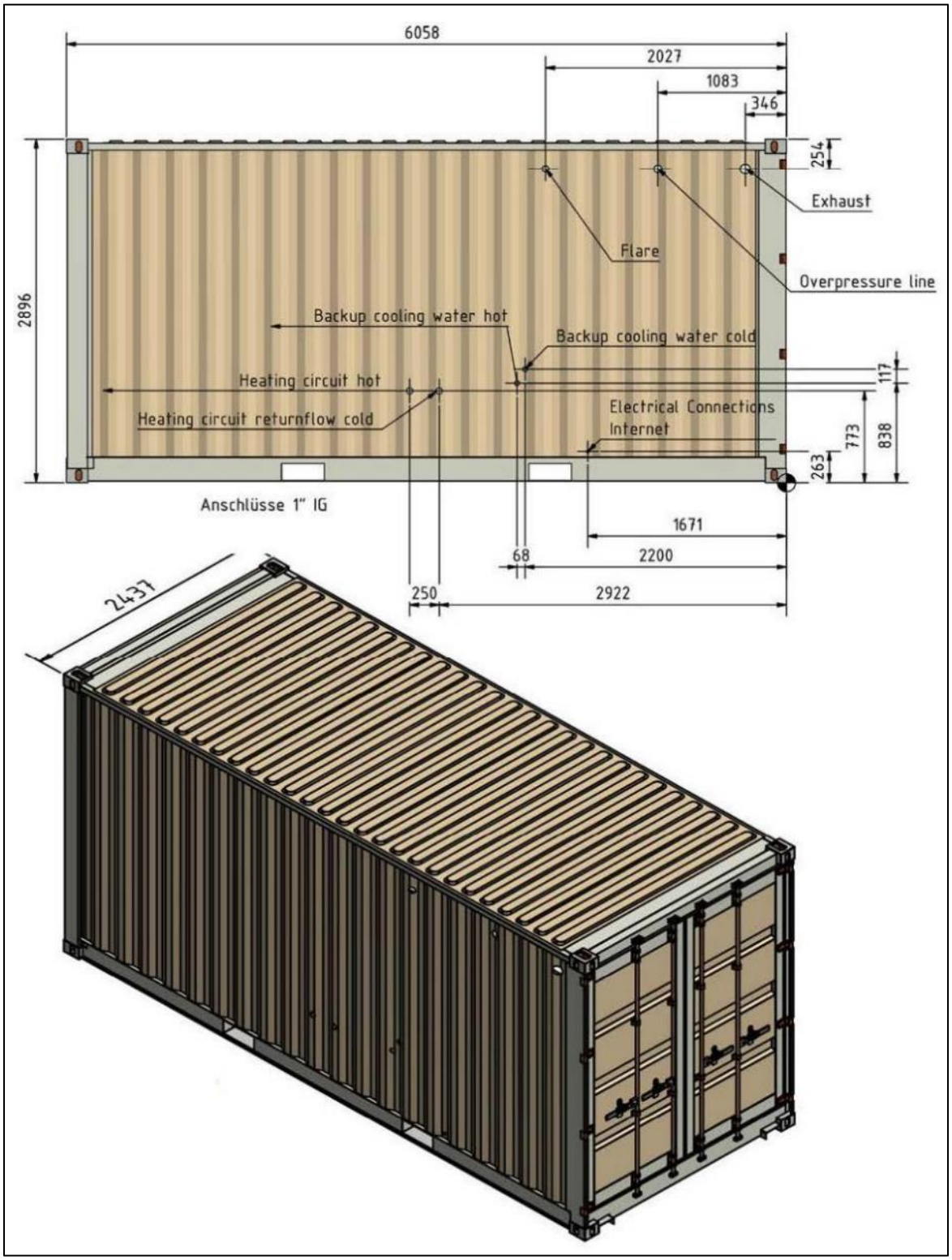
Miscellaneous

Control Unit:	Fully automated operation
Time of commissioning:	2 - 72 hrs
Authorization requirement:	Depends on region

Entrade E4 technical specifications.

2017 Entrade

Figure 22: Entrade Dimensions



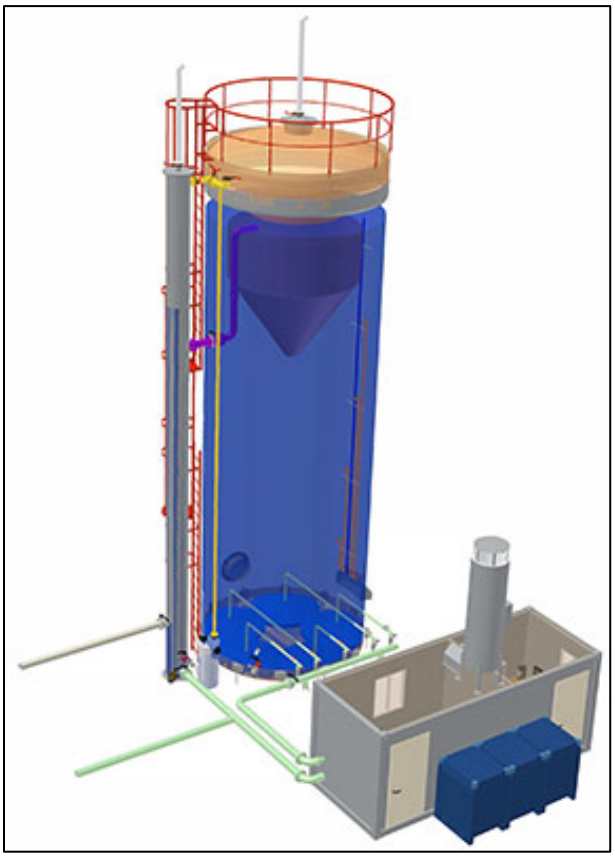
Entrade E4 external dimensions drawing

2017 Entrade

APPENDIX G:
Expanded Granule Sludge Bed Anaerobic Digestion

There are only 14 anaerobic digesters operated in the more than 1,400 dairies in California. Conventional dairy digesters operate at only 20% of their capacity and take 30 days and longer to convert organic waste into biogas. In short, they are not economically viable. By using advanced anaerobic digestion, the same organic waste can be digested in less than 24 hours, and the organic load can be brought to 100% using less than 3% of GBX,[3] a proprietary supplement that has been developed by Biodico. In short, this means less capital cost, a smaller footprint, and more biogas at a faster rate of production.

Figure 23: EGSB Drawing



This is a drawing of one type of EGSB anaerobic digester

2018 Ecologix Environmental Systems

[3] GBX is a proprietary blend of glycerin bottoms from biodiesel production made by Biodico to enhance biogas production in anaerobic digesters.

Expanded Granular Sludge Bed' (EGSB) technology is a form of anaerobic digester that is used for wastewater treatment. The upflow anaerobic sludge blanket (UASB) reactor is a methanogenic (methane-producing) digester that evolved from the anaerobic digester. A similar but variant technology to UASB is the expanded granular sludge bed (EGSB) digester (Ecologix Environmental Systems, 2018). UASB uses an anaerobic process whilst forming a blanket of granular sludge which suspends in the tank. Wastewater flows upwards through the blanket and is processed (degraded) by the anaerobic microorganisms. The upward flow combined with the settling action of gravity suspends the blanket with the aid of flocculants. The blanket begins to reach maturity at around three months. Small sludge granules begin to form whose surface area is covered in aggregations of bacteria. In the absence of any support matrix, the flow conditions create a selective environment in which only those microorganisms capable of attaching to each other survive and proliferate. Eventually, the aggregates form into dense compact biofilms referred to as "granules". Biogas with a high concentration of methane is produced as a by-product, and this may be captured and used as an energy source, to generate electricity for export and to cover its own running power. The technology needs constant monitoring when put into use to ensure that the sludge blanket is maintained, and not washed out (thereby losing the effect). The heat produced as a by-product of electricity generation can be reused to heat the digestion tanks. The blanketing of the sludge enables a dual solid and hydraulic (liquid) retention time in the digesters. Solids requiring a high degree of digestion can remain in the reactors for periods up to 90 days. Sugars dissolved in the liquid waste stream can be converted into gas quickly in the liquid phase which can exit the system in less than a day. UASB reactors are typically suited to dilute waste water streams (3% Total Suspended Solids with particle size greater than.75mm) (Comparisons Between the UASB and the EGSB Reactor, 2018).

APPENDIX H:
Smart Batteries

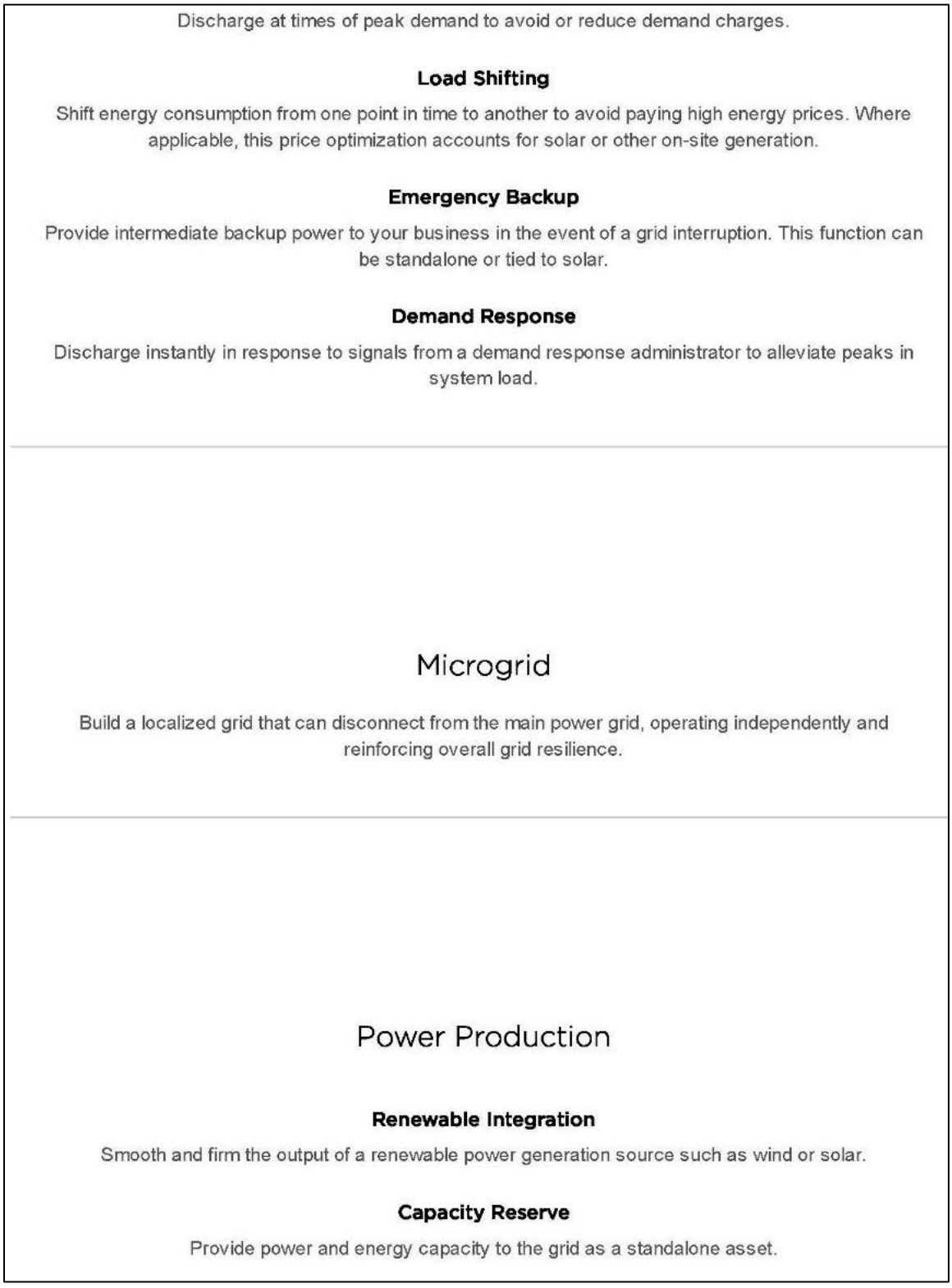
Smart batteries are an essential component of a Virtual Power Plant in making intermittent sources of renewable energy, such as wind and solar, respond to automated dispatch requests. Tesla is one of the manufacturers of two sizes of smart batteries. The Tesla PowerPack is suited for larger installation. The Tesla PowerWall is suited for residences and small businesses.

Figure 24: Tesla PowerPack 2.0 Picture

Internal drawing of the Tesla PowerPack

2017 Tesla

Figure 25: PowerPack Description



Tesla PowerPack description provided by Tesla

2017 Tesla

Figure 26: PowerPack 2.0 Technical Specifications

Energy Capacity	95 kWh (AC) 100 kWh (DC)
Peak Power	50 kW
Depth of Discharge	100%
Certifications	Nationally accredited certifications to international safety, EMC, utility and environmental legislation.
Weight	1,720 kg (3,800 lbs)
Enclosure	IP35 (NEMA 3R)
Dimensions	L x W x H: 1,321 mm (52") x 966 mm (38") x 2,185 mm (86")
Efficiency (DC)*	91% round-trip (2 hour system) 93% round-trip (4 hour system)

PowerPack 2.0 Technical Specifications

2017 Tesla

APPENDIX I:
Smart Lamp / Smart Farm

The Smart Solar/Wind Street Lamp will be built at the ZNEF site using local labor from the New Employment Opportunities[4] program. These workers are heads of families that were formerly on public assistance and are part of the ZNEF Technician Training Program. By combining solar panels and vertical axis wind turbines, lighting can be provided to rural streets and farms that does not impact bird populations and is less expensive to install and maintain. These can be combined with color-controlled LED lights, motion sensors and Wi-Fi to provide light and internet access needed for precision agriculture and to connect rural populations. These will be built in the San Joaquin Valley providing meaningful jobs and economic development for one of the most disadvantaged areas of California. Approximate cost per Smart Street Lamp is $2,500 with a solar/wind charging capacity of 300 watts and a lighting capacity of 1,950 lumens. A working prototype has been built and tested with no funds from this grant and no costs counted as match for this grant.

The Smart Street Lamps will be placed at 50 strategic locations around Red Rock Ranch to provide lighting and a WiFi network for controlling the Smart Batteries and Smart Thermostats installed as part of the Community Energy Efficiency program.

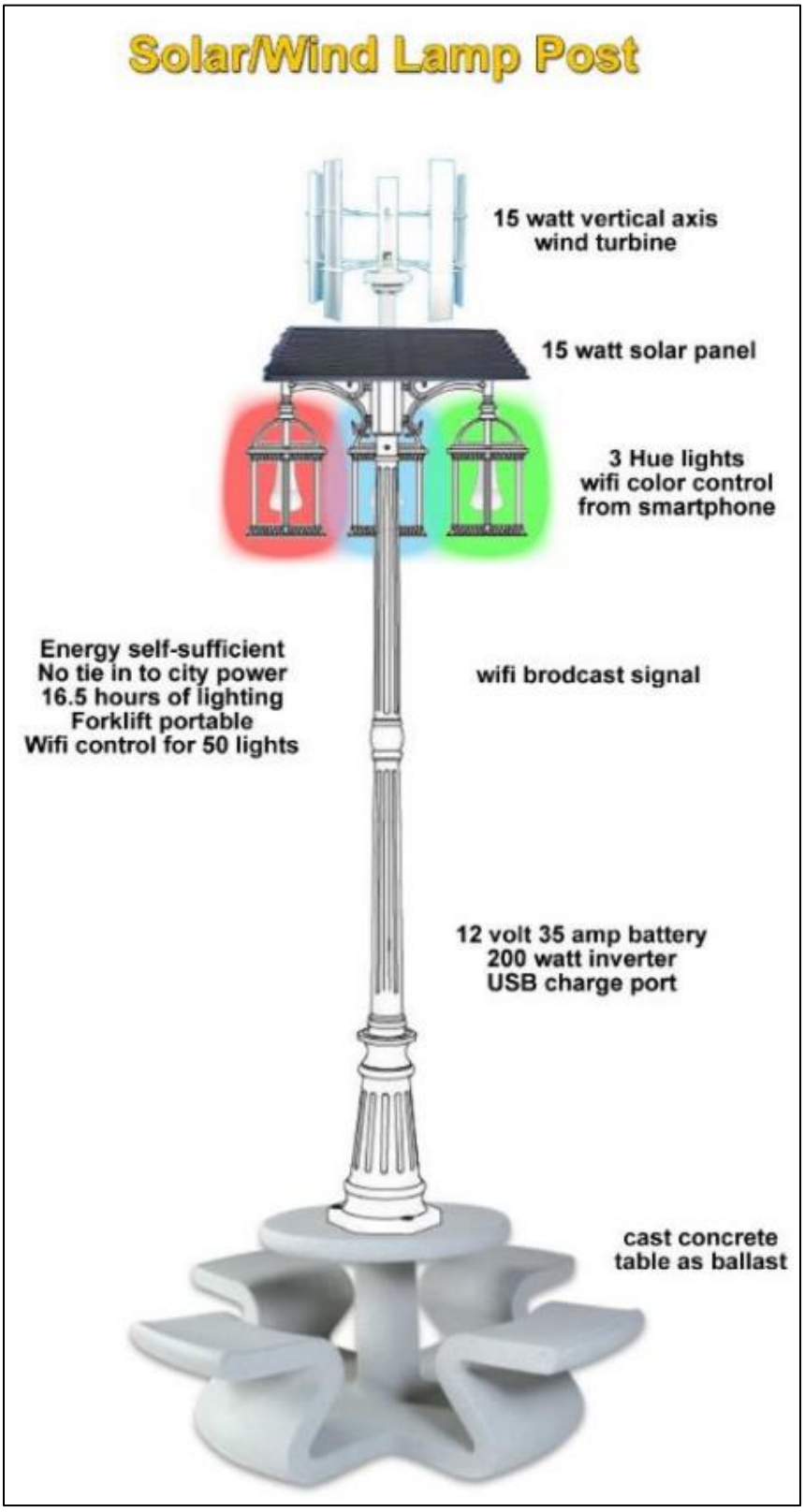
Table 2: Smart Lamp Spacing

Smart Street Lamp Spacing			
Linear Feet	# Lamps	Sides	Spacing Ft.
2,640	50	2	110

2017 Biodico

[4] http://fresnocountycities.com/fcc-incentives/NEO.pdf , November 27, 2017

Figure 27: Smart Lamp Diagram



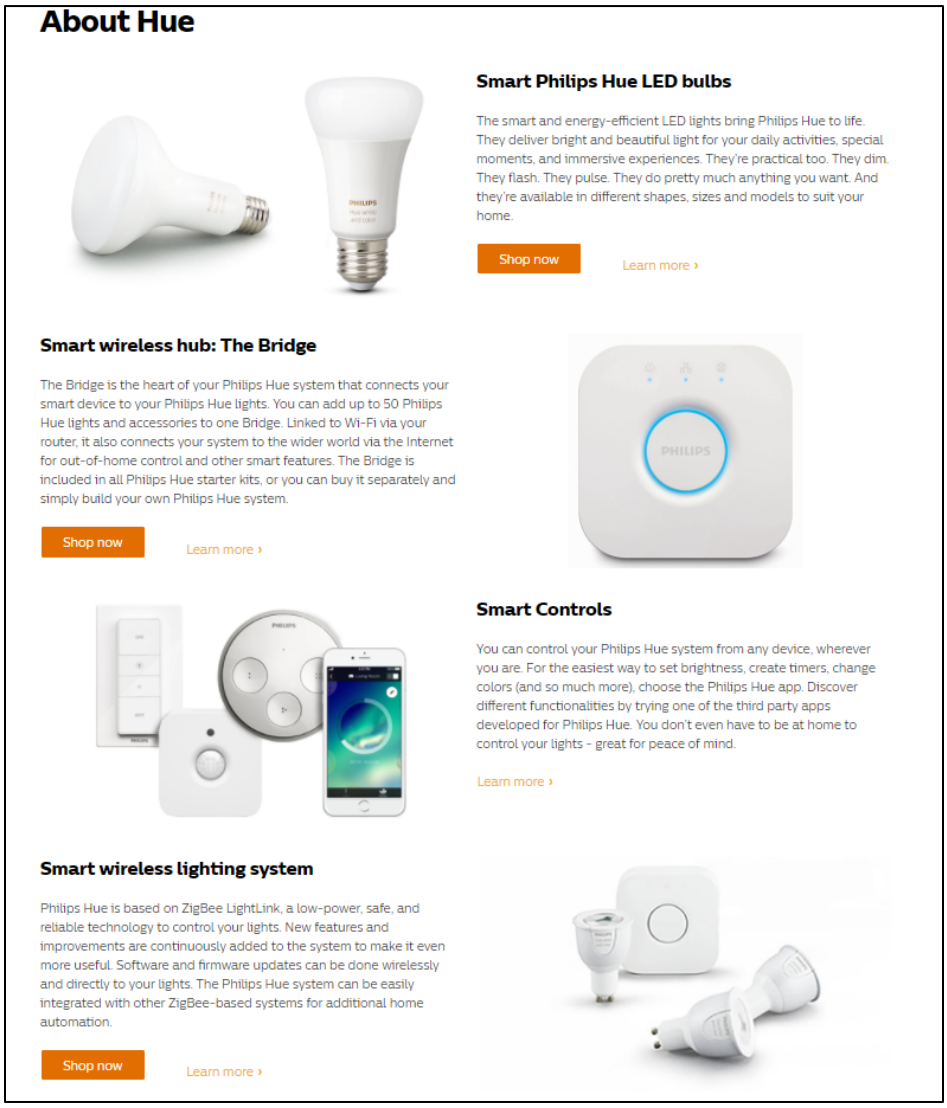
APPENDIX J:
Community Energy Efficiency

Several components will be used as part of the Community Energy Efficiency programs.

LED Lights

Hue Lights controlled by smart phones on either the Android, Apple or Windows platform will be used in Smart Lamps and for Community Energy Efficiency in residences and small business.

Figure 28: Hue LED Light Features



Hue light features can be found on the Phillips web site at https://www2.meethue.com/en-us

Smart Outlets

Smart outlets can control anything that can be plug in at home or in small businesses. Energy intensive appliances, such as dryers, could restrict to run at non-peak demand hours.

Figure 29: Smart Outlets Photograph

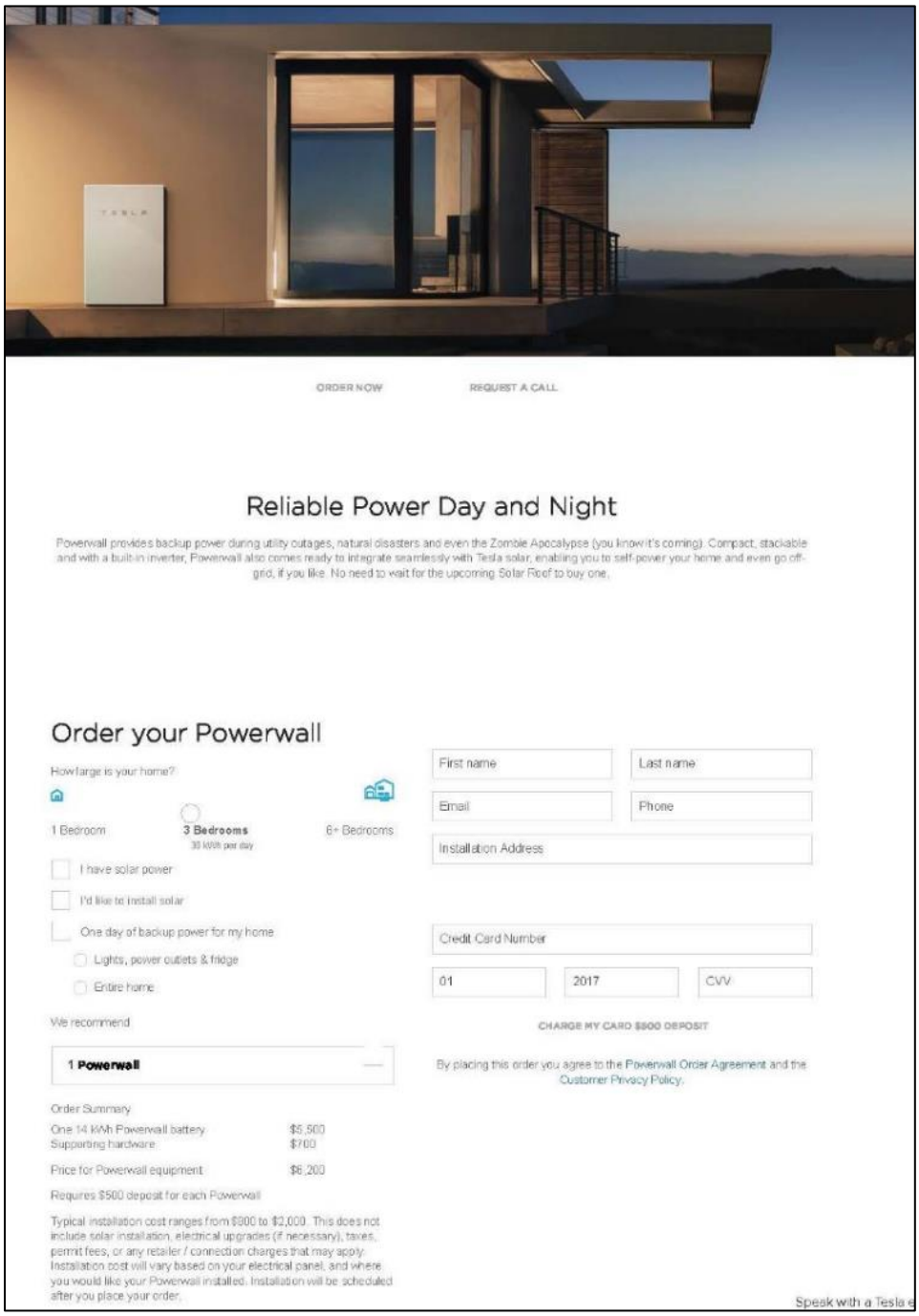
This is one example of many "Smart Outlets" that is being marketed.

2017 Micmi

Tesla PowerWall 2.0

Another component of the Community Energy Efficiency program, the Tesla PowerWall 2.0, allows power shifting to optimized TOU and Nuvve's VPP for automated response to dispatch requests from CAISO/IOU.

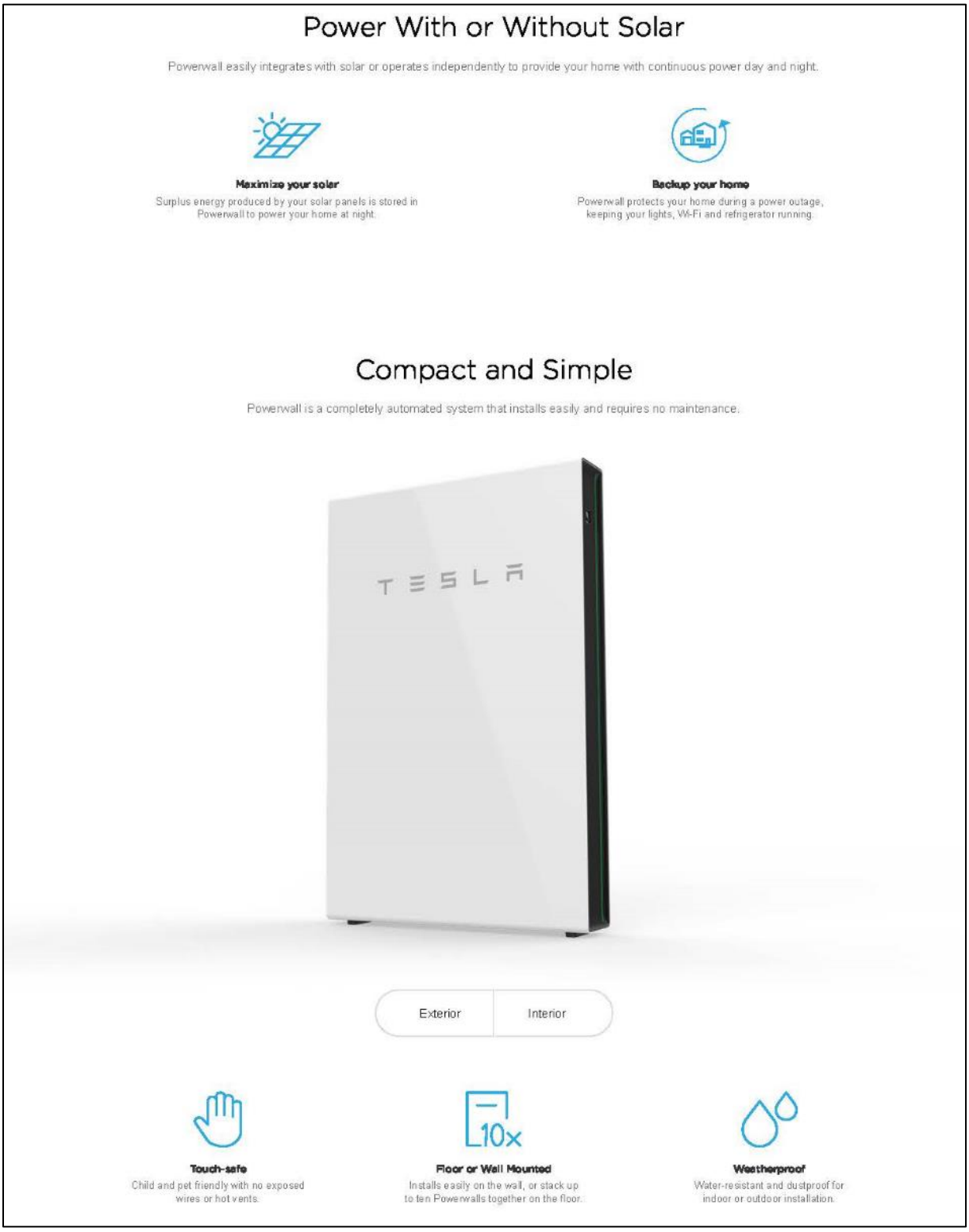
Figure 30: Tesla PowerWall 2.0 Features



Description of the Tesla PowerWall

2017 Tesla

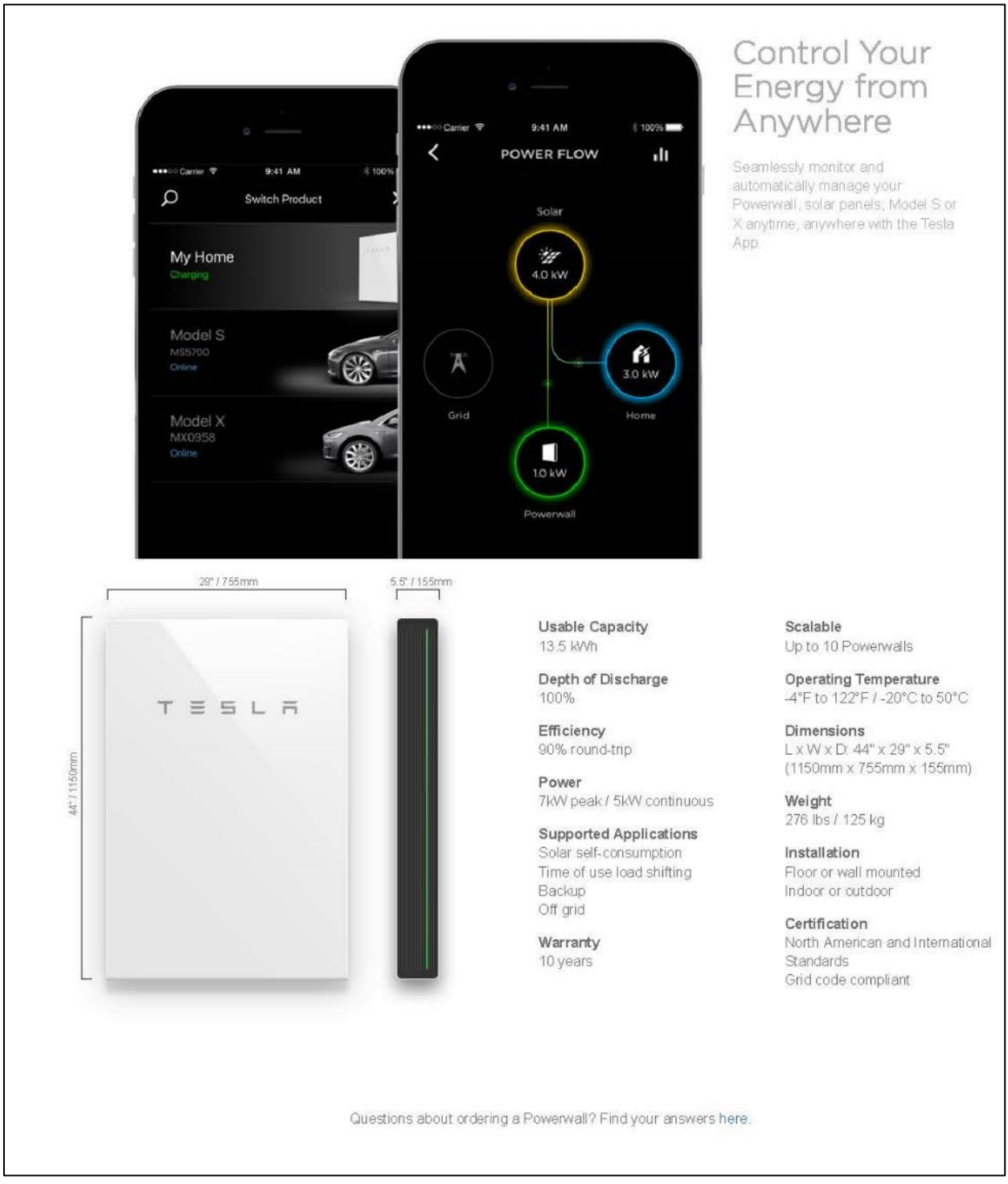
Figure 31: Tesla PowerWall 2.0 Features (continued)



More features of the Tesla PowerWall

2017 Tesla

Figure 32: Tesla PowerWall 2.0 Control



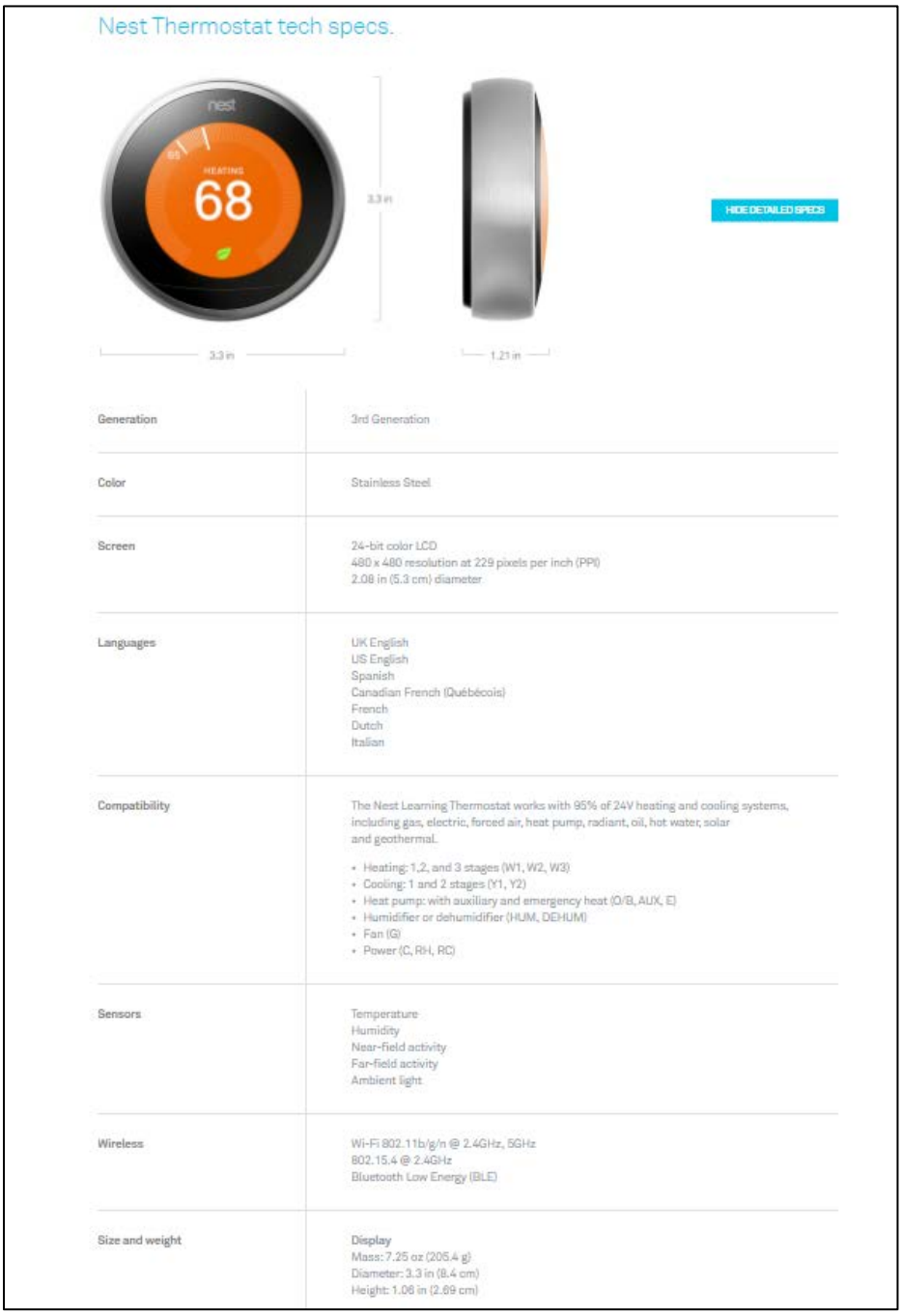
Controls that could be adapted to the Virtual Power Plant

2017 Tesla

Nest

Nest thermostat controls heating and air conditioning, two of the largest energy demands in homes and businesses. Controls could be aggregated to provide major energy shaving during an automated dispatch event, by only changing heating or cooling by a couple of degrees.

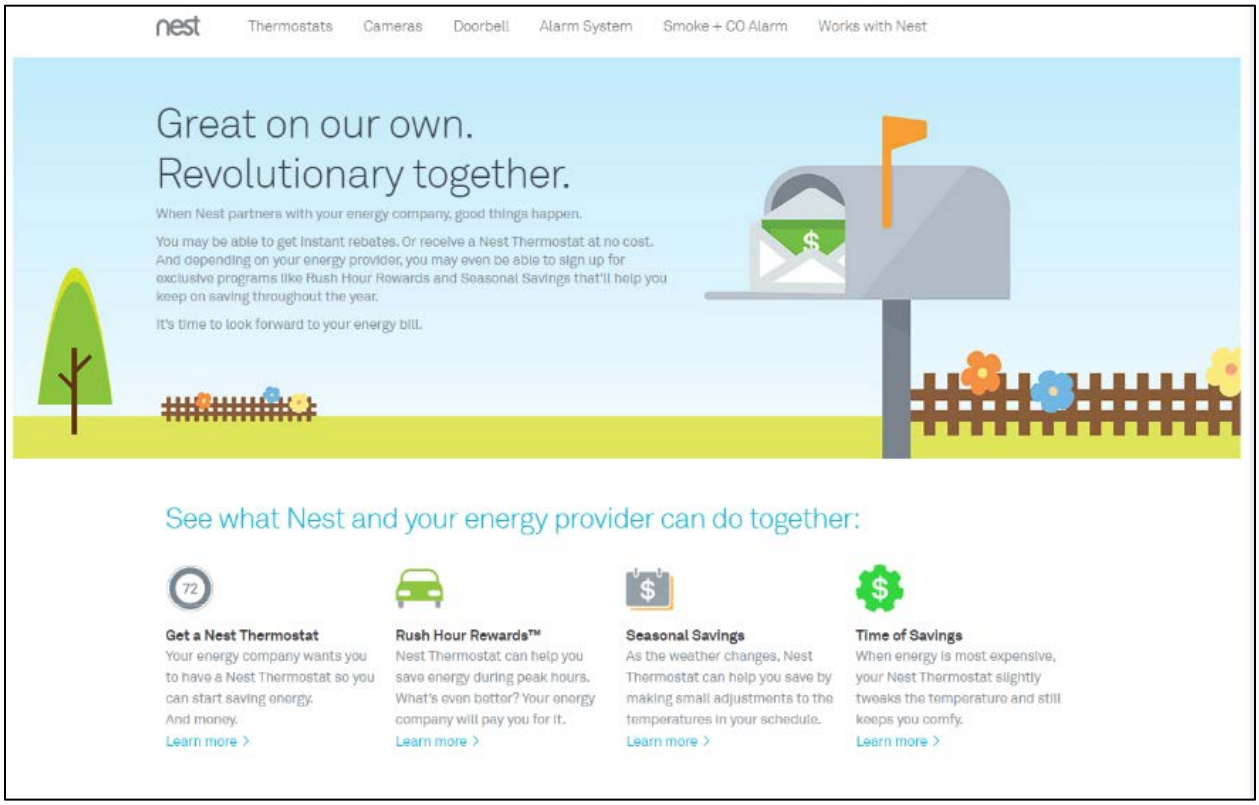
Figure 33: Nest Thermostat Technical Specifications



Description of Nest smart thermostats.

2017 Google

Figure 34: Nest Rebates



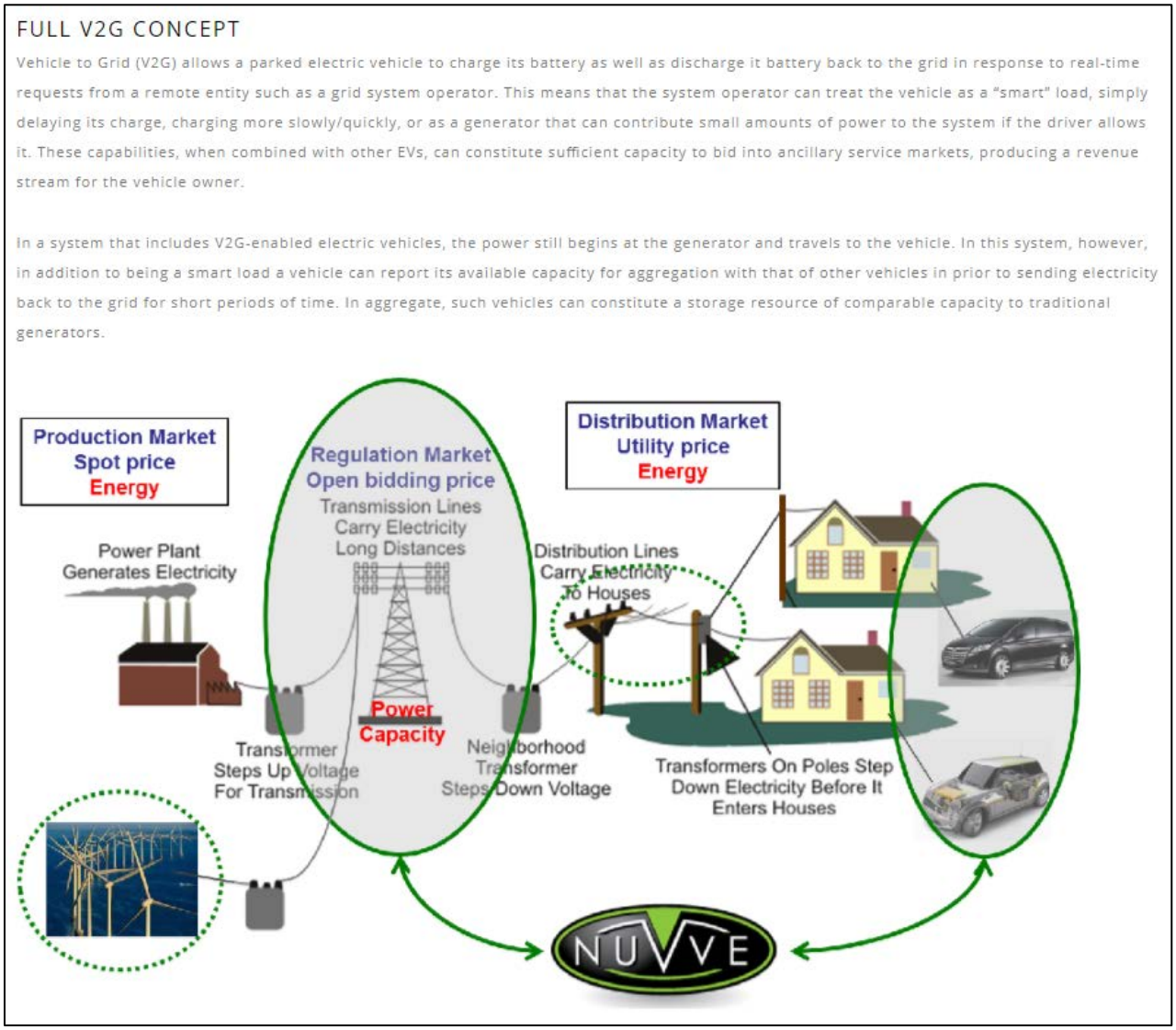
Utility rebates available for installing Nest smart thermostats

2017 Google

APPENDIX K:
Nuvve Vehicle to Grid

The Nuvve Vehicle to Grid (V2G) concept uses the batteries in electric vehicles (EVs) to provide electricity to the grid, as well as to allow the batteries to be charged from the grid at optimal times. This makes the batteries bidirectional so that battery reserves in EV can be drawn upon when needed by the grid.

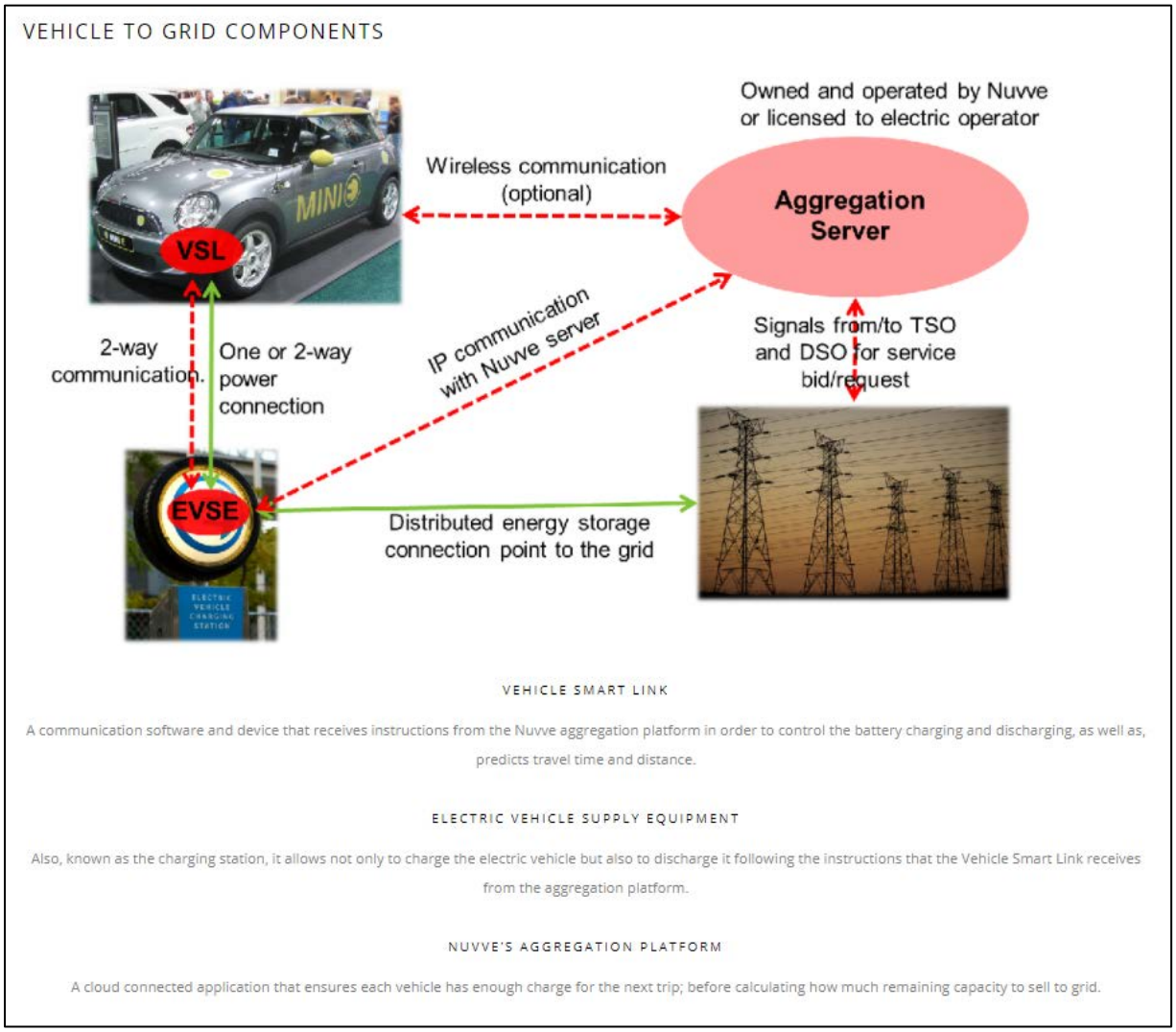
Figure 35: Nuvve V2G Concept



Description of Nuvve's vehicle to grid concept

2017 Nuvve

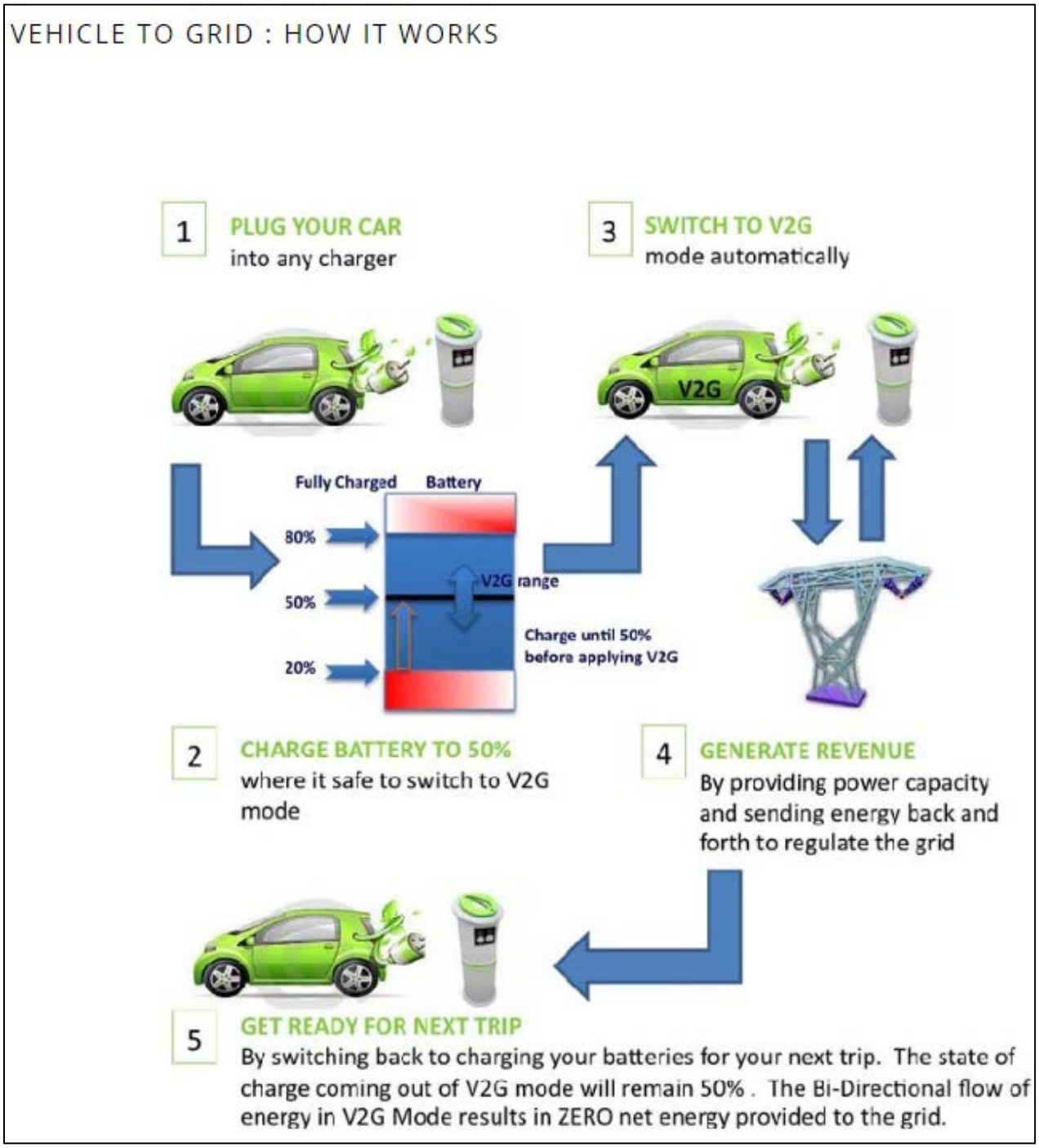
Figure 36: Nuvve V2G Components



Description of Nuvve's vehicle to grid aggregation

2017 Nuvve

Figure 37: Nuvve V2G How It Works



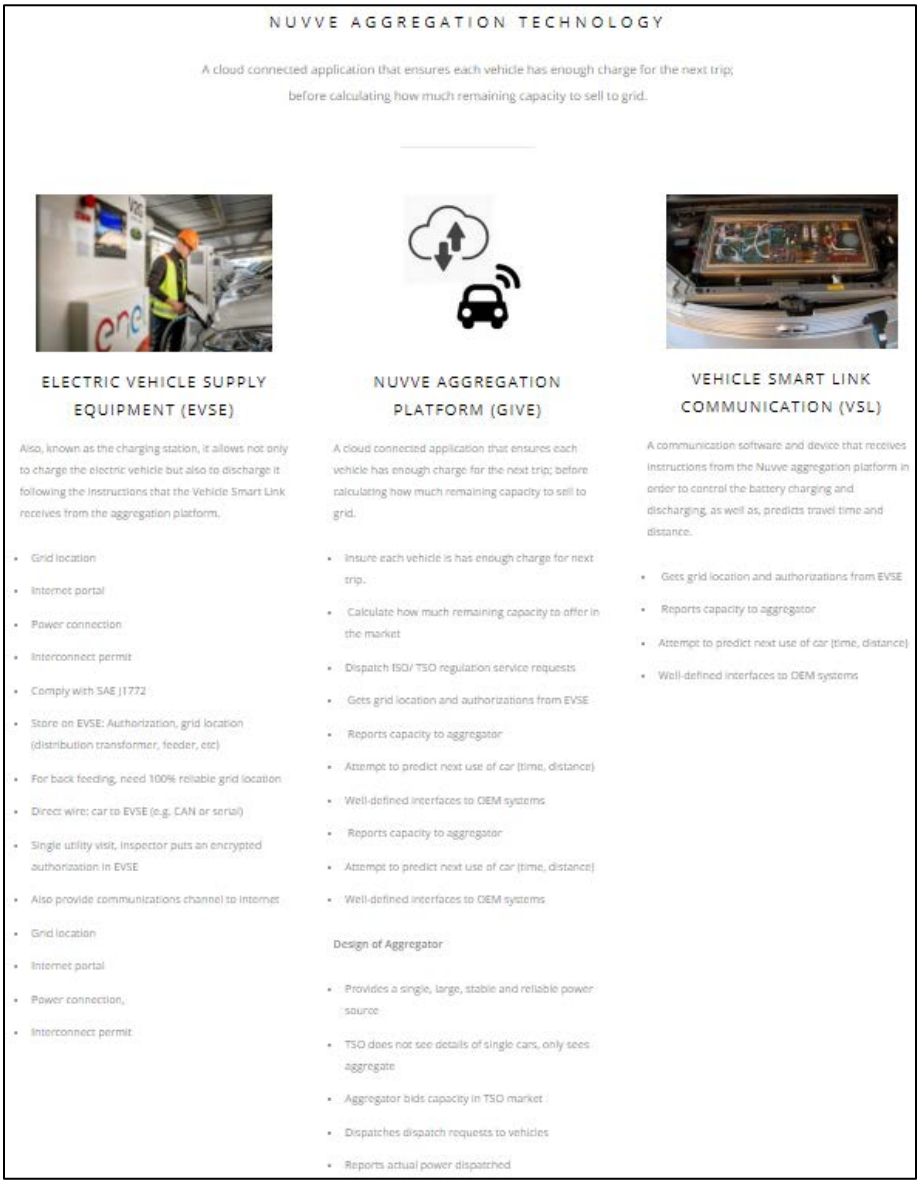
Vehicle to grid diagram

2017 Nuvve

APPENDIX L:
Nuvve Aggregation Platform

Nuvve Aggregation Platform can create Virtual Power Plants from a diverse set of small distributed renewable energy clusters on farm or in farm worker communities. This would enable a new revenue source for small distributed energy projects that could make generating excess energy for export profitable.

Figure 38: Nuvve Aggregation Platform Features



Description of Nuvve's aggregation platform

2017 Nuvve

APPENDIX M:
Request for Proposals

The following is an actual copy of the Request for Proposals that was sent out, and it does not follow the CEC formatting guidelines:

Installation and Integration of Renewable Energy Equipment at the Zero Net Energy Farm in Five Points CA

RFP & Project Contact

Benjamin Peters

CORRELATE

Contact: 505-847-6527

ben@correlateinc.com

Project Lead

Russell Teall, JD

BIODICO
SUSTAINABLE BIOREFINERIES

President & Founder

426 Donze Ave. Santa Barbara, CA 93101

Email: rteall@biodico.com

Project Location

Red Rock Ranch

15946 W. Oakland Avenue, Five Points, CA 93624

1. Introduction

Correlate, Inc. is managing the proposal evaluation and vendor solicitation process for a renewable energy project on behalf the Project Team of Biodico, Inc. and Red Rock Ranch, Inc. This high visibility project is a component of California Energy Commission Grant. The goal of this CEC grant is to demonstrate a model Zero Net Energy Farm (ZNEF), so it can be replicated across the state.

EPC-15-071 Title: Biodico Zero Net Energy Farm **Grant Manager:** Biodico, Inc.

Our team is soliciting proposals from qualified solar and thermal PV providers to design, permit, build and potentially finance a renewable energy installation at the Zero Net Energy Farm in Five Points, CA. Respondents shall have demonstrated experience designing, planning, scheduling, permitting and constructing complete solar electric and thermal PV systems, have relationships with/knowledge of local utilities, provide project financial analysis and rebate support, provide system monitoring and maintenance, and have established onsite safety standards. Of particular importance is past performance and experience with Net Energy Metering Aggregation arrangements and smart batteries. The project will be integrated with wind and internal combustion generators, so feed-in and inverter systems should be compatible.

Decisions regarding the award of this RFP shall be made in the sole discretion of Biodico, an award may or may not be made, and the conditions and specifications may be modified with the mutual consent of the RFP awarded party. Jurisdiction and venue for any disputes arising as the result of this RFP shall be Fresno County, California, according to the rules and conducted by the American Arbitration Association.

A. General Conditions

1. Each respondent is responsible for reviewing and understanding all terms of this Request for Proposal. Failure to thoroughly examine or request clarification on RFP terms may result in disqualification.
2. Any bid may be withdrawn at any time prior to the due date with a written request signed by the authorized respondent representative. Revised proposals may be submitted up to the original due date/time.
3. Issuance of this RFP and receipt of proposals does not commit the Biodico or Red Rock Ranch to move forward with an award or complete the project described. Correlate Inc. reserves the right to postpone the RFP award process, to accept or reject any or all proposals received in response to this RFP, and to modify the scope of the project at any time.
4. An award under this RFP may not be based solely on the lowest price but will be made to the respondent with the overall best value proposal. The successful proposal will meet the project site design guidelines and intended project outcome.
5. Upon notification of short list for award, successful respondent shall secure all appropriate licenses to complete the scope of work included in their proposal

2. RFP Schedule

The schedule for this RFP is as indicated below. It may be modified at the discretion of the Project Team. An addendum will be issued in the event of any scheduling changes.

Project Milestone	**Date/Time**
RFP Advertised/released	August 16, 2017
Optional Site Walk	1pm, Thursday, August 24, 2017
Requests for Information (RFIs) Due	4 days after site walk
Answers to RFIs distributed	2 business days after RFIs submitted
Proposal Due	3 weeks after RFP release (9/6/17)
Notice of Intent to Award	Anticipated 9/19/17
Award Negotiations Complete	Anticipated 9/26/17
Project Notice to Proceed	Anticipated 12/20/17
Final Permitting Complete	Deadline 1/23/2018
System Operation Date	Q4 2018

A. Optional Site Walk

An optional site walk is scheduled for 1pm Thursday, August 24, 2017. All interested firms must coordinate with the project contact to attend the site visit. Participants will meet at location at 15945 W Oakland Ave, Five Points, CA 93624 address at 1pm. Please submit the names of those planning to attend Russ Teall,

B. Project Contacts

Please submit questions via email to Ben Peters and Russ Teall

ben@correlateinc.com (505)847-6527

rteall@biodico.com (805)-683-8103

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C. Selection Process

Depending on the number and quality of the proposals received, the Project Team reserves the right to either select a vendor or shortlist two to three companies. Shortlisted companies may be asked to meet with the Project Team to present their proposal to the decision team and answer any outstanding questions.

3. Project Background

A. Objective

The Project Team of Correlate Inc, Biodico, Inc, and Red Rock Ranch, Inc.; are pursuing a Zero Net Energy Farm as part of an already-awarded California Energy Commission Grant for planning. The overall project will (1) pilot innovative planning, permitting and financing approaches to improve the business case for Advanced Energy Communities (AEC) using Net Energy Meter Aggregation (NEMA) to achieve Zero Net Energy Farms (ZNEF), and (2) develop a real world conceptual design for a ZNEF that includes technical and engineering considerations in a Master Community Design (MCD). Phase 2 of the grant will be awarded at the discretion of the CEC and will involve the implementation of the planned project.

Overview: Solar Canopy Installation & Microgrid Integration
Use Case: Net Energy Meter Aggregation for the two agricultural meters located at the work yard

1. 50 kW Solar PV "Tractor Port"
2. (Optional) Hybrid Solar Thermal & PV Equipment Installation - Fafco CoolPV (or equivalent) to be installed as an awning (10' x 40') on the south side of the Biodico building
3. Smart Batteries 190 kWh
4. Two EV level 2 charging stations, preferred with V2G communication and controls technology
5. Integrate System with existing solar PV, one 50 kW Entrade E4 generator and twelve Missouri wind 2 kW each turbines

B. Project Description

The project site is located at: 15946 W. Oakland Ave, Five Points CA 93624

- **Description of Site:** The Work Yard at Red Rock Ranch and the proposed locations for the renewable energy technologies are located on the map in Exhibit A.
- **Desired System Components and Size:**

Red Rock Ranch Master Community Design Components				
1	Tractor Port	Watts/Electric	Watts/Heat	btu/Heat
	Solar PV (3,700 sqft)	50,000		0
	Wind Turbines (12 two kW each)	24,000		0
2	Fafco CoolPV	6,600	24,000	81,840
3	Smart Flower	2,500		0
4	InnoVentum Giraffe 2.0 (solar/wind EV charger)	10,200		
5	Solar Wind Street Lamp (12)	6,000		0
6	Anaerobic Digester		150,000	511,500
7	Gasifier			0
	Froling T4-150		150,000	511,500
	Entrade E4	50,000	120,000	409,200
8	Smart Batteries	190,000		0
9	EV V2G	24,000		0
	TOTALS	**363,300**	**444,000**	**1,514,040**
	Not to be integrated as part of RFP			
	To be installed by Biodico, but integrated by respondent			
	To be installed & integrated by repondent			

- **Description of Desired Solar System:** Canopy systems and Tractor Ports are the desired structure for the Work Yard, so that farm equipment and materials can still be stored. Optional Fafco CoolPV to be installed as an awning on south side of Biodico building.
- **Smart Batteries:** a minimum of 190 kWh of energy storage capacity stall be provided, capable of peak demand and time of use shaving. To be installed on southwest corner of Biodico building.

- **Integration:** All elements on table above not in blue to be integrated into NEM system. (See scope section 4)
- **Two meters:** to be reduced to one meter for NEM.
- **Project Financing:** Cash Purchase.
- **System Ownership Information:** Biodico, Inc. with grant funding from the CA Energy Commission.
- **Operation & Maintenance:** Respondents are required to include proposals for 5, 10, and 20-year O&M plans for the entire solar electric system. Please include O&M costs as a separate line item for a cash purchased system. Further details are in the O&M section of this RFP.
- **Monitoring:** Install a weather station (temperature, humidity, wind speed and direction, rainfall, and solar insolence) and web display kiosk providing project information should be included.
- **Warranty and Performance Bond** – OEM warranties shall be described and only "bankable" and not potentially impacted by any pending international trade petitions equipment from companies expected to be in business for 20 years will be considered.

4. Scope of Work

Correlate Inc. is soliciting proposals on behalf of the Project Team from qualified solar providers to design, build and potentially finance and operate the project at the site address. The project team is interested in firms that can provide a turn-key installation of a solar canopy and microgrid, including energy storage equipment and EV charging stations, and interconnection and integration services for additional energy generating equipment.

The goal of this RFP is to identify a solar partner with the necessary integration experience to ensure a fully managed and well executed process. The successful respondent will have demonstrated experience financing, designing, planning, scheduling, permitting and constructing, interconnection and maintaining a solar PV and thermal system. Contractor is responsible for all permitting and Meter Aggregation project approval, if applicable. Respondents must have worked with PG&E regulations, provide project financial analysis and have established onsite safety standards. The most important things to the Project Team include:

- An Overall Cost-Effective System
- Advancing the goal of a Zero Net Energy Farm
- Utilization of Advanced Battery Technology
- The potential to generate revenues or otherwise monetize energy generation
- Maintaining the areas under the Tractor Ports as useable work yard space

A. Design Guidelines

Contractor should consider the following guidelines when designing the solar system.

1) Canopy / Tractor Port Solar

The contractor shall develop a design for a new photovoltaic system, with Canopy arrays. It is the responsibility of the contractor to assess site topography and geotechnical attributes to estimate costs related to Project installation. The system shall not exceed the existing interconnection capacity of 50kW

- Tractor Port Canopy shall be at least 12 feet clear in all locations and at least 15' at the end of the north slope.
- It is recommended that Tractor Port solar shall be tilted at a minimum of 10 degrees to allow for drainage and reduce soil build-up.
- Automated cleaning is preferred.
- All lines interconnecting solar arrays to point of interconnection shall be underground.

2) (OPTIONAL) Hybrid Solar Thermal & PV
Example: Fafco CoolPV Awning (or equivalent)

- The awning for the Hybrid system, (such as Fafco CoolPV) shall be 10' x 40' and erected on the south side of the Biodico building.
- It is recommended that the awning be tilted at 15 degrees.
- Automated cleaning is preferred.

For more information on the FAFCO CoolPV system contact
FAFCO Inc. 435 Otterson Dr., Chico, CA. 95928, USA, 95928
Phone: 530-332-2100
https://fafco.com/commercial/

3) Energy Storage / Advanced Battery Proposal

Respondents shall include in their proposals advanced smart batteries capable of storing a minimum range of 190 kWh, and should include:

- Demand Charge and Time of Use Management.
- Tie in to all "Integrated Design Components."
- Smart phone and web read outs.
- Potential lease or revenue share agreements should a battery provide grid support or other value streams in the wholesale power market or distribution system.

4) EV V2G

Two electric vehicle level 2 charging ports shall be included in the bid response. If it is possible the charging stations should include V2G (vehicle to grid) technology so that the vehicle batteries can accept a charge and also discharge to the grid for demand charge and time of use management.

5) Integration

All of the "Integrated Design Components" listed in orange and pink on page 5. Shall be tied into the smart batteries for charging and then the smart battery tied to an inverter for Net Energy Metering. The two meters listed in Exhibit B shall be merged into one account. The intention is to stay within the 50 kW limit of the existing NEM account by using the smart batteries, however – alternative interconnection proposals will be considered.

It is assumed the integration shall take place on the DC side of the array, but a hybrid integration of DC and AC connections will be considered. The Project Team is interested in selecting a Respondent who is capable of providing design and interconnection guidance based on the most recent interconnection and net energy metering guidelines by the CEC and CPUC.

B. Financial Analysis Guidelines

A financial analysis of this microgrid project is not required and economic forecasts will be factored into the team experience and qualification section. Respondents may provide optional information on system financing alternatives and high level economic assumptions.

C. Code Specifications

All power generation and transmission equipment must be UL listed for its designed use. Construction must comply with current adopted State Building Code, which includes: International Building Code, National Electric Code (NEC) and State Fire Marshall (if applicable).

- **Modules:** System modules shall be UL1703 listed, and CEC-listed
- **Inverters:** Shall be UL1741 listed and must be CEC-listed with an efficiency of 95% or higher
- **Inverters:** Inverters should have Rule 21 Smart Inverter functionality. Please include commentary on the Smart Inverter requirement and functionality in your proposal.

D. Contractor Responsibilities

The final design package and documents shall include the following but are not all required in the proposal stage. Please reference the proposal requirement section for detailed bid submission requirements:

- Description of the solar system
- Construction documents and engineering calculations
- Layout drawing of installation site providing location of all equipment
- Equipment details and specifications
- Schedule for equipment procurement and installation
- Description of how PG&E grid interconnection, and meter aggregation requirements will be met
- Description of controls, monitors, and instrumentation to be used for the solar system
- Equipment and installation manuals
- Safety plan
- Quality control plan
- Operations and Maintenance manuals for system operations and performance monitoring over the life of the contract
- Web-based monitoring for 20 years
- Close out report including the following information: system nameplate size, the overall installed cost of the system and estimated and guaranteed annual kilowatt hour (kWh) production (if applicable).

E. Warranties

The solar provider's standard system warranty coverage should cover modules, inverter, racking and interconnection workmanship.

- **Modules:** 25-Year Power Output & 10 Workmanship Limited Warranty
- **Inverter:** 10-Year Limited Warranty, Provide a price and/or plan for inverter replacement in year 11 and beyond
- **Racking:** 10-Year Limited Warranty priority
- **Workmanship:** 2 Year Limited Warranty
- **Performance degradation should be set forth**

F. System Monitoring

The Project Team will favor a proposal that includes a turnkey monitoring system that can be integrated into an asset management portal for ongoing O&M and reporting. Revenue Grade monitoring is encouraged. The system should display and analyze historical and live solar electricity generation data. Additionally, the regularly collected data should reflect, but not be limited, to the following:

- Average and accumulated output (kWh/kW and total kWh)
- Capacity factor
- Air quality emissions averted (and real world equivalents conversion)
- Weather station historic and current data

G. Operation and Maintenance of System

Respondents will be required to include proposals for 5, 10, and 20 year O&M plans for operation and maintenance of the entire solar electric system. Operations and maintenance services include:

- Online monitoring
- Performance monitoring, notification, and troubleshooting – must have personnel available to notify the Project Team of an outage or decrease in system production
- A Service Level Agreement describing maximum response time for system issues, and maximum time to respond to issues that require field service.
- Corrective maintenance to mitigate any risk to the system or minimize down time
- System Performance Reports that compares actual production to predicted production
- Preventative maintenance and inspections to identify and fix problems before they occur, including infrared photography for hot spots, manufacturer recommended maintenance, hardware torque checks, and array cleanings

Successful respondents shall supply the Project Team two copies of all Component Product Data and Component Operation and Maintenance manuals. The information shall be sufficient for the Project Team to evaluate and ensure appropriate O&M is being completed over the life of the system. Examples of components include solar panels, conduit, inverter, net metering equipment, etc. Project as-builts that detail location of all above and underground utilities and components shall be submitted within 60 days of system start-up.

5. Proposal Requirements

Electronic Submissions will be accepted for this Project. It is the responsibility of the respondent to ensure that the submittal is received in a timely manner. Please address proposals to

Name: Russ Teall
COMPANY NAME: Biodico
Address: 426 Donze Ave., Santa Barbara, CA 93101
Email: rteall@biodico.com

A. Proposal Format

Please include the following sections in your proposal submittal in the following order.

- **Cover/Transmittal letter**: Cover letter must be addressed to Biodico and Red Rock Ranch and signed by a legally authorized representative of the respondent. Cover letter must summarize key provisions of the proposal and must include name, address, phone and email of the respondent contact.
- **Executive Summary***:* Include key provisions of the proposal, including understanding of project goals, pricing, respondent's role on project, brief description of proposed system, financing, relevant experience of respondent/company, and key timeline dates.
- **Company Profile***:* Years in business, description of respondent/company background, applicable state licensing, OSHA background and safety protocol, Insurance, Quality Assurance/Quality Control documentation.
- **Project Experience:** Include projects completed in the last 2 years similar in scope and size to the proposed project. Project Experience with NEM Aggregation is highly encouraged. Include project name, system size, location, and brief 2-3 sentence project description. Highlight companies permitting, approval, and interconnection experience with local authorities and utility.
- **References:** Provide 3 project references with direct client phone numbers.
- **Project Team:** Organization chart and bios (length of time with firm, key projects) of key team members, capability to perform work/workload capacity. Please only profile individual that will directly be working on this project. Clearly identify the project manager.

- **Technical Solution/Scope of Work:** Describe your technical approach to the design and construction of the solar project including:

    - Technical Approach, Design, Equipment, Installation
        - Panel, inverter, racking specifications
        - Equipment and workmanship warranties
    - Exhibits showing proposed layouts and system single line diagrams
    - PVSYST or equivalent Report indicating production of the proposed system
    - Proposed monitoring system/solution
    - Operations & Maintenance Plan offered for the project. Please price O&M plans separately

- **Production Guarantee:** Provide a 20-year Production Guarantee, with at least a 90% kWh guarantee for year 1, degrading by a maximum of 0.5%/year for 20 years. Performance guarantee should be measured and damages should be paid on an annual basis.
- **Price Proposal:** Provide a cash purchase price for the system. Optional system financing offers for entire technology stack or individual system components may be considered
    - Present year 1, 5, 10 and 20-year financial forecast
    - Present the NPV and other investment metrics using standard avoided cost estimates
    - PPA/Lease proposal may include a percent escalator
- **Safety** – Please include a brief description of the safety practices of your firm, as well as the OSHA Reporting Indicators for the last 3 years.
- **Proposed Schedule** – Identify key project milestones and include any necessary review periods for the Project Team.
- **Disclosure** – List all laws suits in which the company has been involved during the past 3 years.

6. Evaluation/Selection Criteria:

The Project Team will evaluate proposals according to the evaluation criteria below. Result of this step will be the identification of the selection of a proposal for negotiation of a contract. Points will be awarded based on the relative merit of the information provided in the response to the solicitation. Selection based on the total number of points awarded by the evaluation committee.

- Proposal Cost Effectiveness 35 points
- Technical Approach/ Implementation Schedule 30 points
- Company Qualifications/Project Experience 20 points
- Project team, team experience and approach 15 points

The Project Team may elect to conduct interviews with selected respondents to ask questions or for more detail on the proposed project. The team reserves the right to seek supplemental information from any respondent at any time after official proposal opening and before award. This will be limited to clarification or more detail on information included in the original proposal. Upon acceptance of a proposal and intent to award, the successful respondent will be required to execute and return all required project documents and certificates of insurance within 30 days from the Notice of Award. Should the selected firm fail or refuse to execute the project documents, the Project Team reserves the right to accept the proposal of another firm.

7. RFP Exhibits

Exhibit A: Site plan with solar and technology areas identified

Exhibit B: Farm Map and two-meter locations

APPENDIX N:
StorageVET Readouts

StorageVET version 1.0.1.81 was used to model three different scenarios; (1) a Tesla Powerpack 2.0 [130kW/338kWh] in a commercial setting, (2) a Tesla Powerwall 2.0 [7kW/13.5kWh] in a residential setting, and (3) a Tesla Powerwall 2.0 [7kW/13.5kWh] in a commercial setting. All three models were run with parameters set in accordance with the GFO 17-302 instructions on page 41: both the Debt Interest Rate and Equity Rate were set at 7% on the Financials Tab. The following tables and charts show the results for the three models and include the NPV Cost/Benefit Chart, Total Project NPV, Net Cost of Capacity ($/kW-year), and Breakeven Capital Costs ($/kWh).

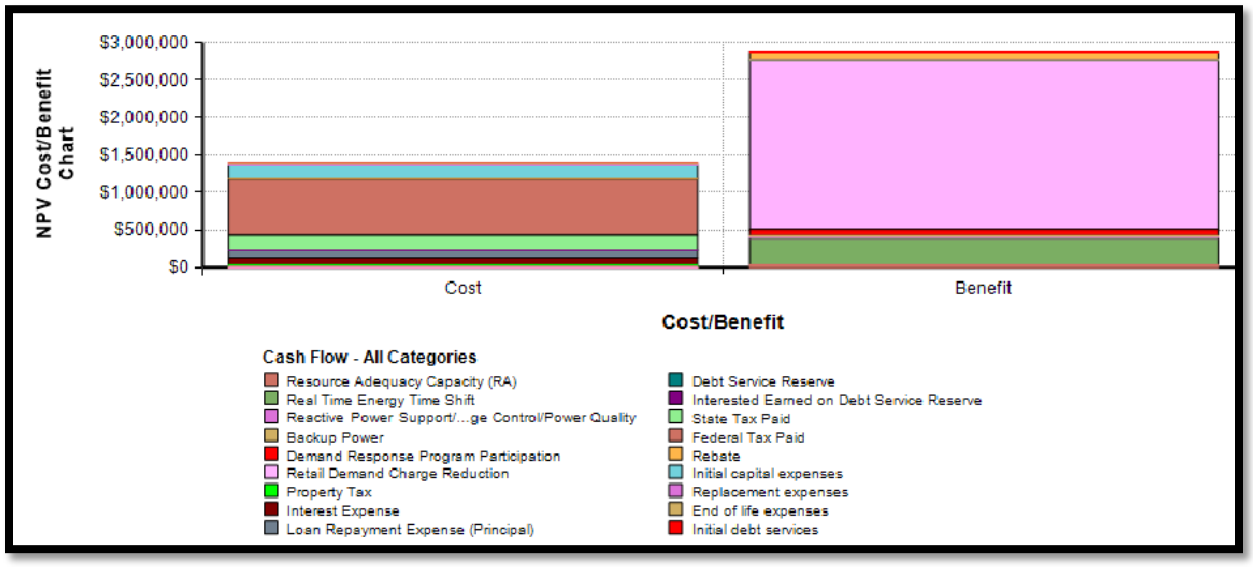
Table 3: StorageVET Model Run for Tesla PowerPack and PowerWall

Read Out from StorageVET Fianancial Results with GFO Required Parameters Set	1. Tesla Powerpack 2.0 Commercial		2. Tesla Powerwall 2.0 Residential		3. Tesla Powerwall 2.0 Commercial	
Item	Cost	Benefit	Cost	Benefit	Cost	Benefit
Resource Adequacy Capacity (RA)	$ -	$ 33,741	$ -	$ -	$ -	$ -
Day Ahead Energy Time Shift	$ -	$ -	$ -	$ -	$ -	$ -
Real Time Energy Time Shift	$ -	$ 360,668	$ -	$ -	$ -	$ -
Frequency Regulation	$ -	$ -	$ -	$ 5,283	$ -	$ 5,201
Spinning Reserve	$ -	$ -	$ -	$ 55	$ -	$ 239
Non-Spinning Reserve	$ -	$ -	$ -	$ 3	$ -	$ 12
Reactive Power Support/Voltage Control/Power Quality	$ -	$ 16,715	$ -	$ -	$ -	$ -
Backup Power	$ -	$ 13,929	$ -	$ 16,715	$ -	$ 16,715
Demand Response Program Participation	$ -	$ 83,661	$ -	$ 3,341	$ -	$ 3,341
Regulation Energy Settlement	$ -	$ -		$ 499	$ 747	$ -
Retail Demand Charge Reduction	$ -	$ 2,251,257	$ -	$ -	$ -	$ 12,094
Retail Energy Time Shift	$ -	$ -	$ -	$ 3,789	$ -	$ 19,914
Transfer Payments of any kind	$ -	$ -	$ -	$ -	$ -	$ -
Fixed O&M	$ -	$ -	$ -	$ -	$ -	$ -
Variable O&M	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax	$ 28,085	$ -	$ 1,320	$ -	$ 1,320	$ -
Interest Expense	$ 104,377	$ -	$ 4,904	$ -	$ 4,904	$ -
Loan Repayment Expense (Principal)	$ 92,414	$ -	$ 4,342	$ -	$ 4,342	$ -
Debt Service Reserve	$ -	$ 2,800	$ -	$ 132	$ -	$ 132
Interest Earned on Debt Service Reserve	$ -	$ 3,444	$ -	$ 162	$ -	$ 162
Sales Tax Paid	$ 203,807	$ -	$ 1,367	$ -	$ 3,229	$ -
State Tax Refund	$ -	$ -	$ -	$ 678	$ -	$ 145
Federal Tax Paid	$ 751,482	$ -	$ 4,996	$ -	$ 12,153	$ -
Federal Tax Refund	$ -	$ -	$ -	$ 1,760	$ -	$ 275
Tax Credit - Federal ITC	$ -	$ -	$ -	$ -	$ -	$ -
Rebate	$ -	$ 101,957	$ -	$ 6,394	$ -	$ 6,394
Utilities Incentive	$ -	$ -	$ -	$ -	$ -	$ -
Initial Capital Expense	$ 175,527	$ -	$ 8,247	$ -	$ 8,247	$ -
Replacement Expenses	$ 26,318	$ -	$ 1,765	$ -	$ 1,765	$ -
End of Life Expense	$ 676	$ -	$ 34	$ -	$ 34	$ -
Initial Debt Service	$ 8,284	$ -	$ 389	$ -	$ 389	$ -
Fuel Cost	$ -	$ -	$ -	$ -	$ -	$ -
Subtotals	**$ 1,390,970**	**$ 2,868,172**	**$ 27,364**	**$ 38,811**	**$ 37,130**	**$ 64,624**
Total Project NPV	**$1,477,200**		**$11,445**		**$27,494**	
Net Cost of Capacity ($/kW-year)	**$0**		**$0**		**$0**	
Breakeven Capital Cost ($/kWh)	**$7,330**		**$2,442**		**$4,153**	

This is a copy of the spreadsheet output from the model run by Biodico

2017 EPRI and Biodico

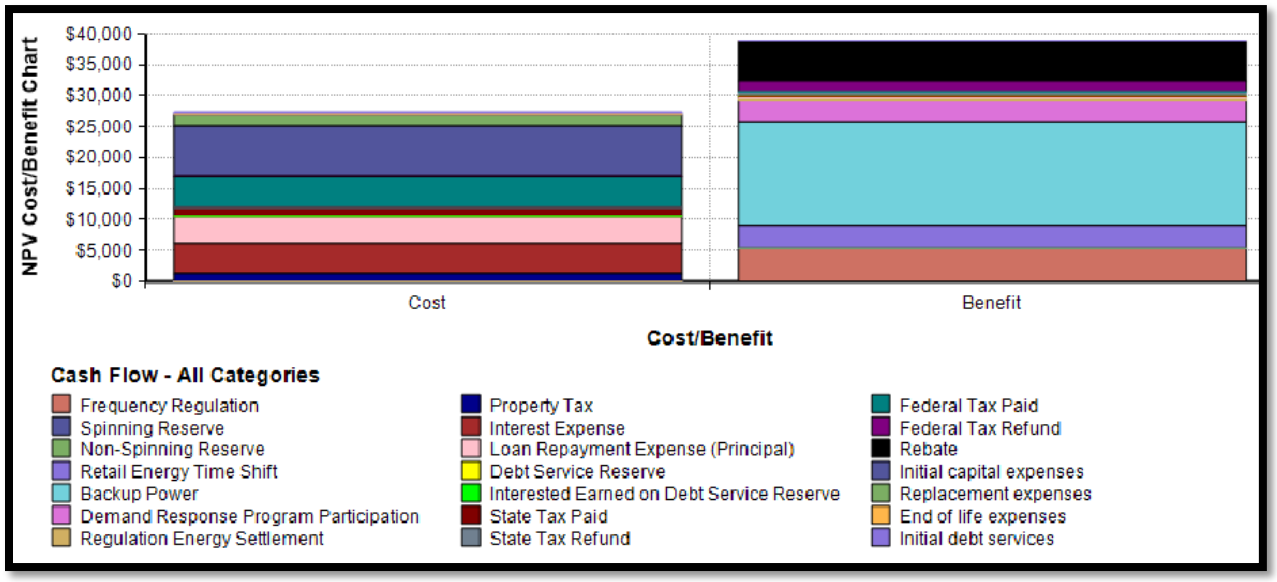
Figure 39: Tesla Powerpack 2.0 in a commercial setting



StorageVET readout from model run by Biodico

2017 EPRI and Biodico

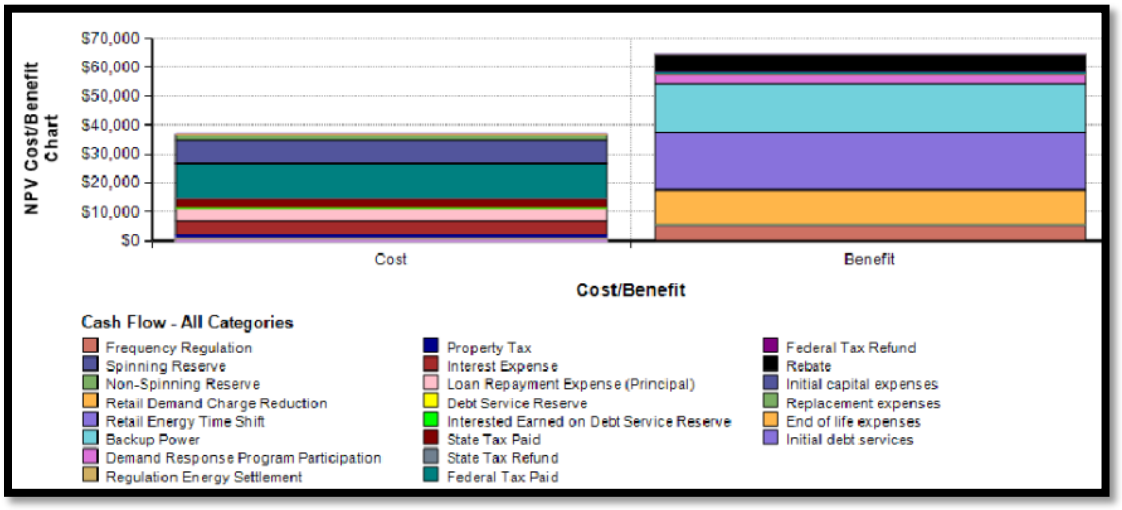
Figure 40: Tesla Powerwall 2.0 in a residential setting.



StorageVET readout from model run by Biodico

2017 EPRI and Biodico

Figure 41: Tesla Powerwall 2.0 in a commercial setting



StorageVET readout from model run by Biodico

2017 EPRI and Biodico

APPENDIX O:
Cost of Power Outages

"In 2016, the average duration of power outages for a PG&E customer was 109 minutes. That was up slightly from 96 minutes in 2015." PG&E Currents, March 14, 2017

Table 4: PG&E Power Interruptions

PG&E Power Interruptions					
Year	Minutes/Customer[1]	Customers[2]	Total Minutes	Total Days	Total Years
2015	96	5,311,178	509,873,088	354,079	970
2016	109	5,349,691	583,116,319	404,942	1,109
1. PG&E, Currents, May 2017					
2. PG&E, Annual Shareholder Reports, 2016 & 2017					

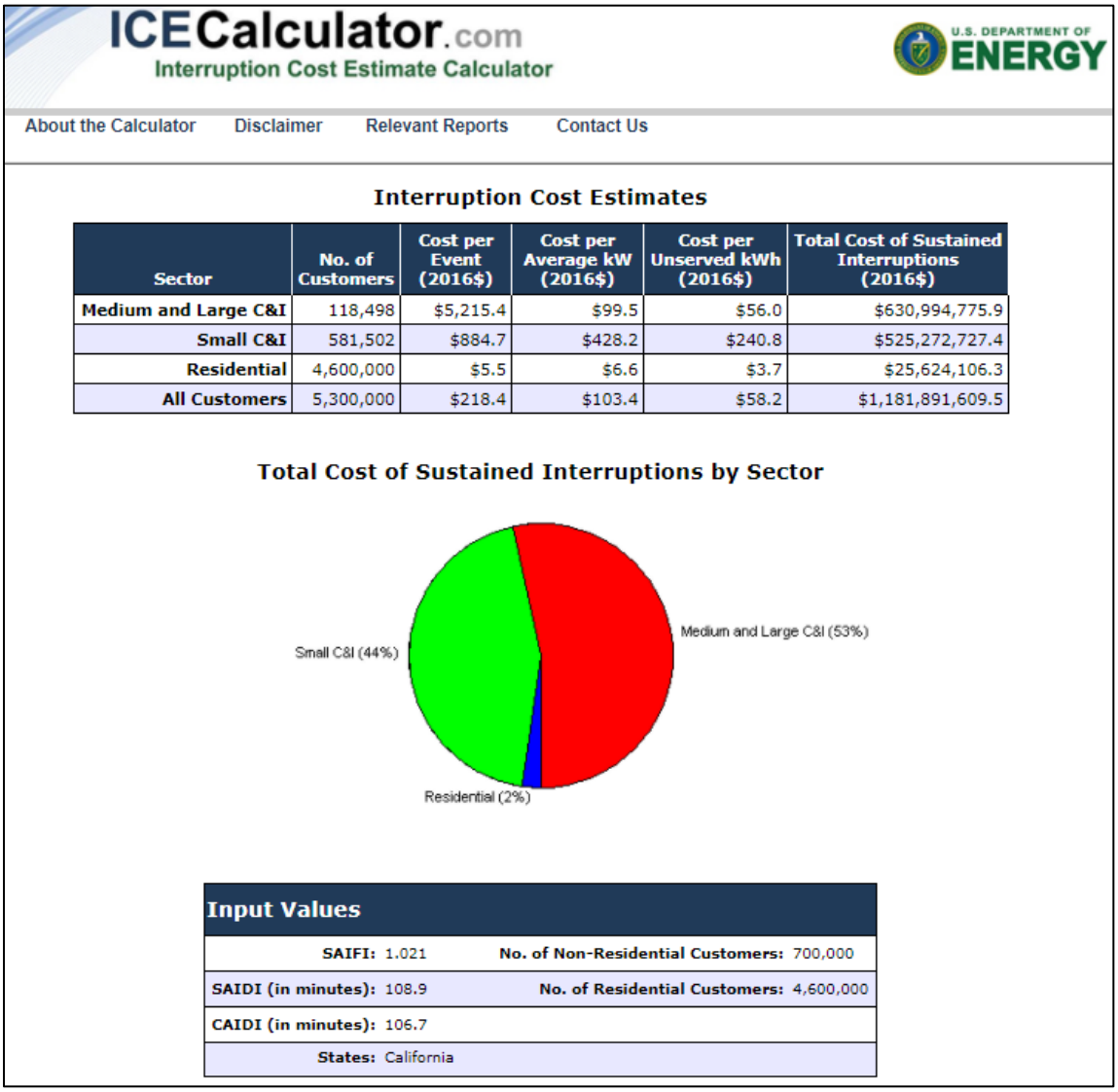
Total computed interruptions of power for 2015 and 2016.

2017 Biodico

The above table is based upon SAIDI, SAIFI and CAIDI[5] data from, PG&E, 2016 Annual Electric Reliability Report, July 14, 2017. As shown in the figure below, the total cost of sustained power interruptions for PG&E in 2016 was almost $1.2 billion.

[5] SAIDI System Average Interruption Duration Index , SAIFI System Average Interruption Frequency Index, CAIDI Customer Average Interruption Duration Index, https://nocapx2020.info/wp-content/uploads/2010/04/pages-17-19-from-rpu2009_e_and_o_report.pdf

Figure 42: Interruption Cost Estimate Calculator



ICECalculator.com
Interruption Cost Estimate Calculator

U.S. DEPARTMENT OF ENERGY

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Interruption Cost Estimates

Sector	No. of Customers	Cost per Event (2016$)	Cost per Average kW (2016$)	Cost per Unserved kWh (2016$)	Total Cost of Sustained Interruptions (2016$)
Medium and Large C&I	118,498	$5,215.4	$99.5	$56.0	$630,994,775.9
Small C&I	581,502	$884.7	$428.2	$240.8	$525,272,727.4
Residential	4,600,000	$5.5	$6.6	$3.7	$25,624,106.3
All Customers	5,300,000	$218.4	$103.4	$58.2	$1,181,891,609.5

Total Cost of Sustained Interruptions by Sector

Input Values			
SAIFI:	1.021	No. of Non-Residential Customers:	700,000
SAIDI (in minutes):	108.9	No. of Residential Customers:	4,600,000
CAIDI (in minutes):	106.7		
States:	California		

ICECalculator model run by Biodico using power interruption results provided by PG&E

2017 USDOE and Biodico

APPENDIX P:
RIMs II Modeling

The ZNEF business opportunity analysis was conducted using data and multipliers for Fresno County supplied by the U.S. Department of Commerce, Bureau of Economic Analysis Regional Input-output Modeling System II (BEA's RIMS II). RBEA RIMS II multipliers estimate how much a one-time or sustained increase in economic activity in a particular region will be supplied by industries located in the region. RIMS II provide six types of multipliers: final-demand multipliers for output, earnings, employment, and value added; and direct-effect multipliers for earnings and employment. In turn, systematic analysis of economic impacts must account for the inter-industry relationships within regions because these relationships largely determine how regional economies are likely to respond to project and program changes. For example, construction spending has variable impacts on grocery stores, banks, filling stations, etc. The following table shows how the Biodico ZNEF will expand business opportunities for California-based businesses without multipliers. This includes vendors, project participants and distributors. Categorizing budget expenditures according to pre-established RIMS categories is the first step in the RIMS methodology.

Using RIMS II for impact analysis has several advantages. RIMS II multipliers can be estimated for any region composed of one or more counties and for any industry, or group of industries, in the national I-O table. Empirical tests show that estimates based on relatively expensive surveys and RIMS II-based estimates are similar in magnitude. Type I multipliers include workers that live and work in the region, and Type 2 multipliers exclude those workers. This accounts for all net purchases of goods and services in the region by applying both types of multipliers to the budget categories. The table below shows the final economic and employment impact of the BIV project.

The charts below are the RIMS II Type 1 and Type 2 multipliers specifically generated for Fresno County by the US Bureau of Economic Analysis and commissioned by BIV.

These tables show the number of direct jobs created by the BIV project. RIMS II was also used to predict the relationship between direct and indirect jobs created by the proposed project. As shown in the previous table the total number of direct and indirect jobs generated by the BIV project is 274.

Table 5: RIMS II Multipliers for Fresno County

RIMS II Multipliers for Fresno County								
ID#	Category	Type	1. Final-demand Output ($)	2. Final-demand Earnings ($)	3. Final-demand Employment (# of jobs)	4. Final-demand Value-added ($)	5. Direct-effect Earnings ($)	6. Direct-effect Employment (# of jobs)
7	Construction	1	1.2439	0.4253	8.3565	0.649	1.1836	1.2079
		2	1.5741	0.5147	10.7954	0.8492	1.4322	1.5605
25	Chemical manufacturing	1	1.419	0.2241	2.8885	0.5693	1.6055	1.9116
		2	1.5931	0.2712	4.1735	0.6748	1.9427	2.7619
32	Truck transportation	1	1.2615	0.3488	8.2872	0.6133	1.3049	1.2993
		2	1.5324	0.4221	10.2875	0.7775	1.579	1.613
34	Pipeline transportation	1	1.1872	0.534	6.1864	0.7223	1.1234	1.2466
		2	1.6018	0.6462	9.2487	0.9737	1.3594	1.8637
48	Professional, scientific, and technical services	1	1.1216	0.5113	7.8522	0.7884	1.0742	1.1199
		2	1.5186	0.6187	10.7841	1.0291	1.2998	1.5381
49	Management of companies and	1	1.1522	0.5061	5.9581	0.7378	1.0979	1.1743
		2	1.5452	0.6124	8.8599	0.976	1.3286	1.7462
50	Administrative and support services	1	1.1499	0.4719	16.9148	0.7593	1.1021	1.0657
		2	1.5163	0.5711	19.6209	0.9815	1.3336	1.2362

This is a copy of the spreadsheet run by Biodico using the RIMS II data for Fresno County.

2017 Biodico

Table 6: RIMS II Impacts During Biodico Project

RIMS II Impacts During Biodico Project								
Category	Type	Budget	1. Final-demand Output ($)	2. Final-demand Earnings ($)	3. Final-demand Employment (# of jobs)	4. Final-demand Value-added ($)	5. Direct-effect Earnings ($)	6. Direct-effect Employment (# of jobs)
Construction	1	$ 3,575,000	$ 4,446,943	$ 1,520,448	29.87	$ 2,320,175	$ 4,231,370	4.32
	2		$ -	$ -	-	$ -	$ -	-
Chemical manufacturing	1	$13,000,000	$ 18,447,000	$ 2,913,300	37.55	$ 7,400,900	$20,871,500	24.85
	2	$20,175,000	$ 32,140,793	$ 5,471,460	84.20	$13,614,090	$39,193,973	55.72
Truck transportation	1	$ 250,000	$ 315,375	$ 87,200	2.07	$ 153,325	$ 326,225	0.32
	2	$ 250,000	$ 383,100	$ 105,525	2.57	$ 194,375	$ 394,750	0.40
Pipeline transportation	1	$ 125,000	$ 148,400	$ 66,750	0.77	$ 90,288	$ 140,425	0.16
	2	$ 125,000	$ 200,225	$ 80,775	1.16	$ 121,713	$ 169,925	0.23
Professional, scientific, and technical services	1	$ 125,000	$ 140,200	$ 63,913	0.98	$ 98,550	$ 134,275	0.14
	2	$ 1,250,000	$ 1,898,250	$ 773,375	13.48	$ 1,286,375	$ 1,624,750	1.92
Management of companies and	1	$ 250,000	$ 288,050	$ 126,525	1.49	$ 184,450	$ 274,475	0.29
	2	$ 375,000	$ 579,450	$ 229,650	3.32	$ 366,000	$ 498,225	0.65
Administrative and support services	1	$ 100,000	$ 114,990	$ 47,190	1.69	$ 75,930	$ 110,210	0.11
	2	$ 250,000	$ 379,075	$ 142,775	4.91	$ 245,375	$ 333,400	0.31
Totals		**$39,850,000**	**$ 59,481,850**	**$11,628,885**	**184.07**	**$26,151,545**	**$68,303,503**	**89.43**
Total Economic Impact			**$165,565,783**		**Total Employment Impact**		**274**	

This is a copy of the spreadsheet run by Biodico using the RIMS II data for Fresno County.

2017 Biodico

Table 7: Jobs Created by ZNEF

Jobs Created by the Biodico ZNEF Project				
Function	Jobs	Skill	Type	Location
ZNEF	3	Management	Permanent	Five Points
	6	Technician	Permanent	Five Points
	12	Laborer	Permanent	Five Points
	2	Driver	Permanent	Five Points
	3	Sales	Permanent	Five Points
AD	2	Technician	Permanent	Five Points
Cogen	2	Technician	Permanent	Five Points
Biogas	2	Technician	Permanent	Five Points
	3	Laborer	Permanent	Five Points
	3	Sales	Permanent	Five Points
Admin	2	Management		
Subtotal	40		Permanent	
Constructior	20	Multiple	Temporary	Five Points
Fabrication	10	Multiple	Temporaty	Five Points
Subtotal	30		Temporary	
TOTAL	70			

This is a copy of the spreadsheet run by Biodico using the RIMS II data for Fresno County.

2017 Biodico

State and local tax impacts of the Biodico Sustainable Biorefinery are over $11,000,000 annually as shown in the following figure. Even accounting for sales tax forgiveness under the CAEFTA program, there will be $10,754,575 paid in taxes to the State of California, $363,559 in local taxes.

Table 8: Tax Impact of the Biodico ZNEF

Tax Impact of the Biodico ZNEF						
Item	Amount	Tax Type	Tax Rate	State Tax	Tax Rate	Local Tax
Construction (1st year only	$ 4,075,000	Sales	CAEFTA	$ -	0.725%	$ 29,544
Property	$ 4,075,000	Property	0%		1.053436%	$ 42,928
Payroll	$ 2,250,000	EDD/SUI	3.50%	$ 78,750		
Personal Income*	$ 2,250,000	Income	8.84%	$ 198,900		
LLC Member Income**	$ 10,250,000	Income	35.72%	$ 3,661,300		
Biodiesel Sales/$	$ 40,000,000	Sales	7.50%	$ 3,000,000	0.725%	$ 290,000
Biodiesel Sales/gal	10,000,000	Excise/Fee	$ 0.38	$ 3,800,000		
Biomethane Sales/$	$ 150,000	Sales	7.50%	$ 11,250	0.725%	$ 1,088
Biomethane Sales/gge	50,000	Use	$ 0.0875	$ 4,375		
			Subtotals	$10,754,575		$ 363,559
			TOTAL	$11,118,134		
*Based on $50,000 income for married filing jointly						
**Based on $500,000 distribution for married filing jointly						

This is a copy of the spreadsheet run by Biodico calculating the estimated tax impact of the ZNEF project.

2017 Biodico

APPENDIX Q:
Project Management Application Report

Summary of ZNEF GeoPlanner

Biodico developed location and resource availability software designed expressly for the integration of renewable energy into IOU electric grids, which facilitate site location optimization. The web-based Project Management Application (PMA) with Geographic Information System (GIS) tool, is called the Zero Net Energy Farm (ZNEF) GeoPlanner. It is based on an existing software application created by ESRI to facilitate the planning, permitting and financing of a ZNEF. The ZNEF GeoPlanner is a web-based tool that utilizes solar, wind and biomass data, geographically overlaid on a map of California, to estimate energy generation when considering the use of the following distributed energy resources (DERs): solar, anaerobic digestion, gasification and/or wind turbine energy generation technologies whose parameters are also contained within the ZNEF GeoPlanner.

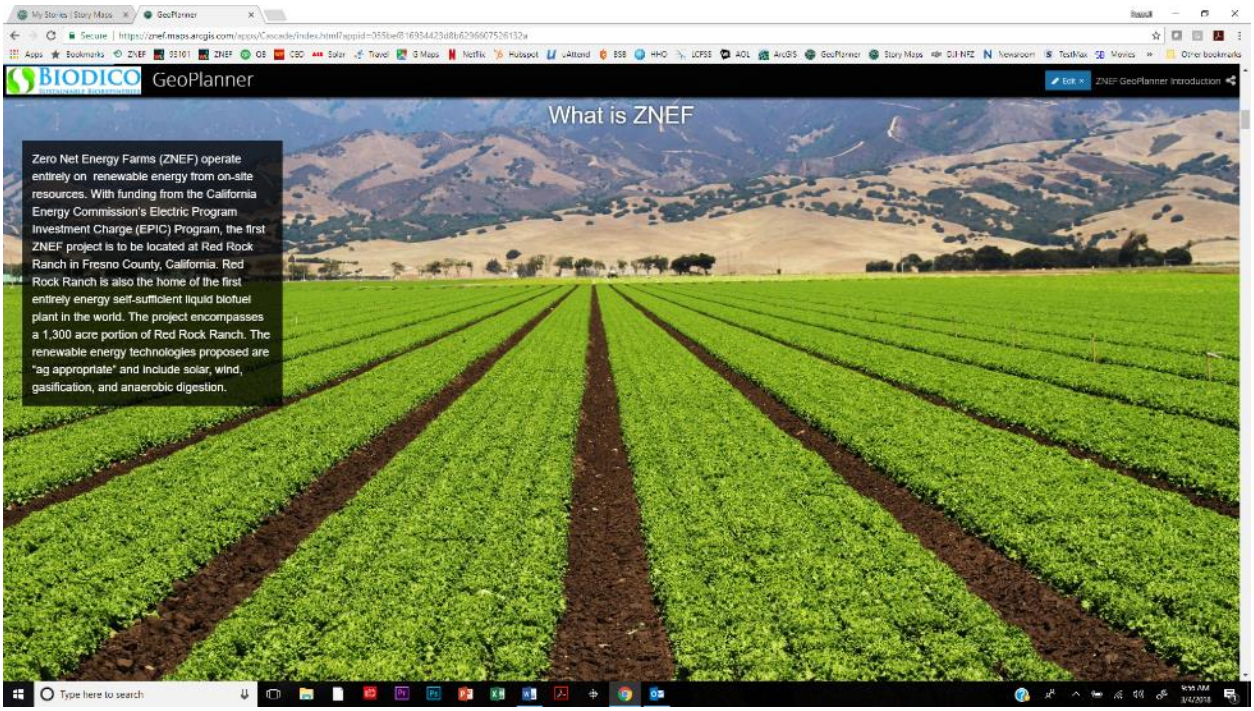
ZNEF GeoPlanner optimizes, or down-selects, the various energy generation technologies and/or planning, permitting, and financing options for a given Zero Net Energy Farm. It does this by (1) performing a resource assessment for solar, wind and biomass energy potential, (2) referring to a library of distributed renewable energy technologies, for example, numerous vendors for solar panels, wind turbines, gasifiers and anaerobic digesters, (3) taking inputs for the types of energy use on a particular property, for example to total kWh consumed, the time of use, demand charges and the tariff, and (4) optimizing available resources and their corresponding technologies to meet the energy needs of the property with the most economical solution for the area available. ZNEF GeoPlanner also includes boundary maps for the various California Air Districts as well as available financing options, incentives and subsides.

It is important to note that the ZNEF GeoPlanner is only available to licensed users and that due to the complexity of the ZNEF GeoPlanner, a potential user of the ZNEF GeoPlanner would need assistance from Biodico and ESRI to act as a facilitator, consultant and guide for using the ZNEF GeoPlanner.

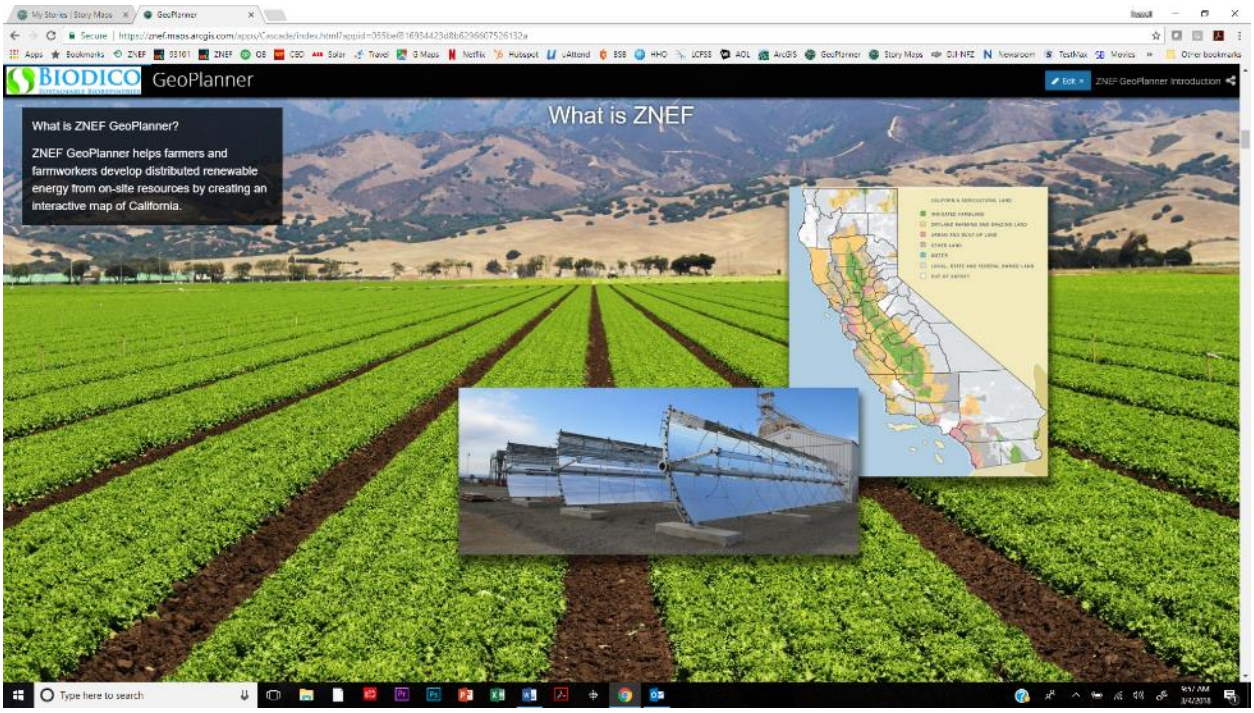
Introduction to the Zero Net Energy Farm Story Map

These are screen shots of the Story Map for the Zero Net Energy Farm (ZNEF). It is designed to be a self-paced introduction to the ZNEF GeoPlanner, which requires professional assistance to provide an analysis for a particular agricultural property in California. The Story Map Introduction provides an overview of the capabilities of the ZNEF GeoPlanner. A link to the ZNEF GeoPlanner Story Map is as follows: https://znef.maps.arcgis.com/apps/Cascade/index.html?appid=055bef816934423d8b6296607526132a

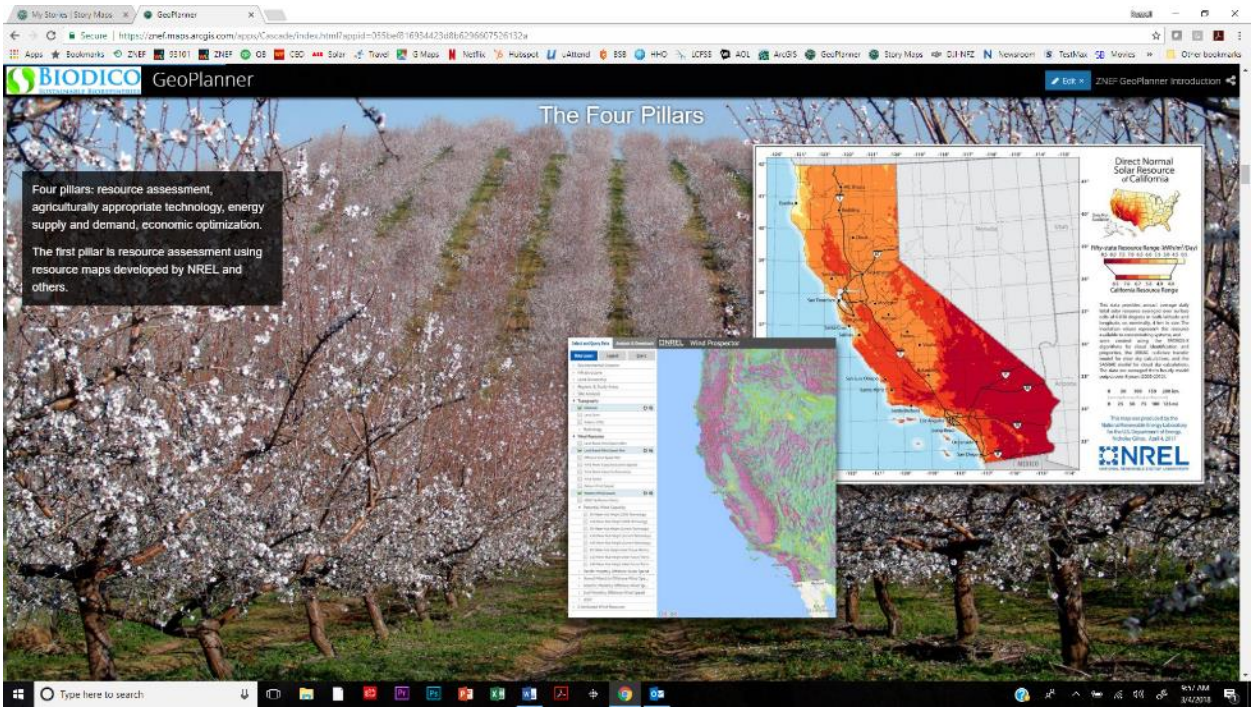
Story Map begins by answering the question, "What is the Zero Net Energy Farm?"



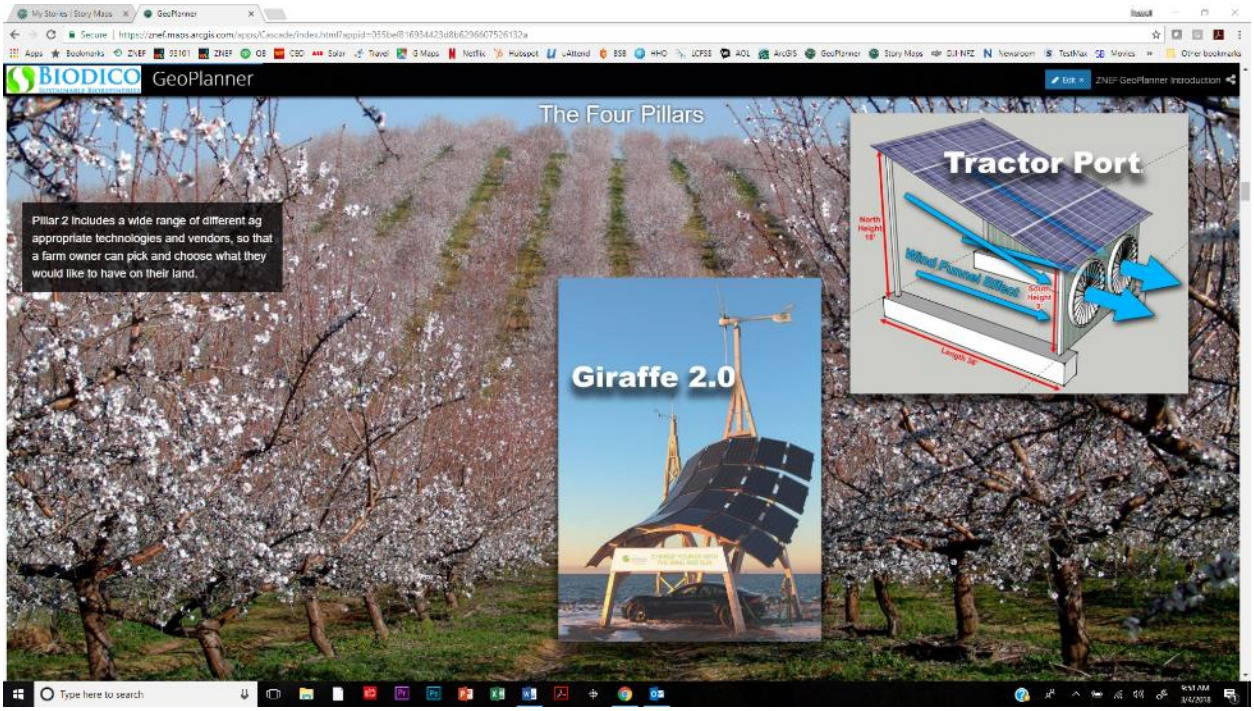
What is the Zero Net Energy Farm GeoPlanner?



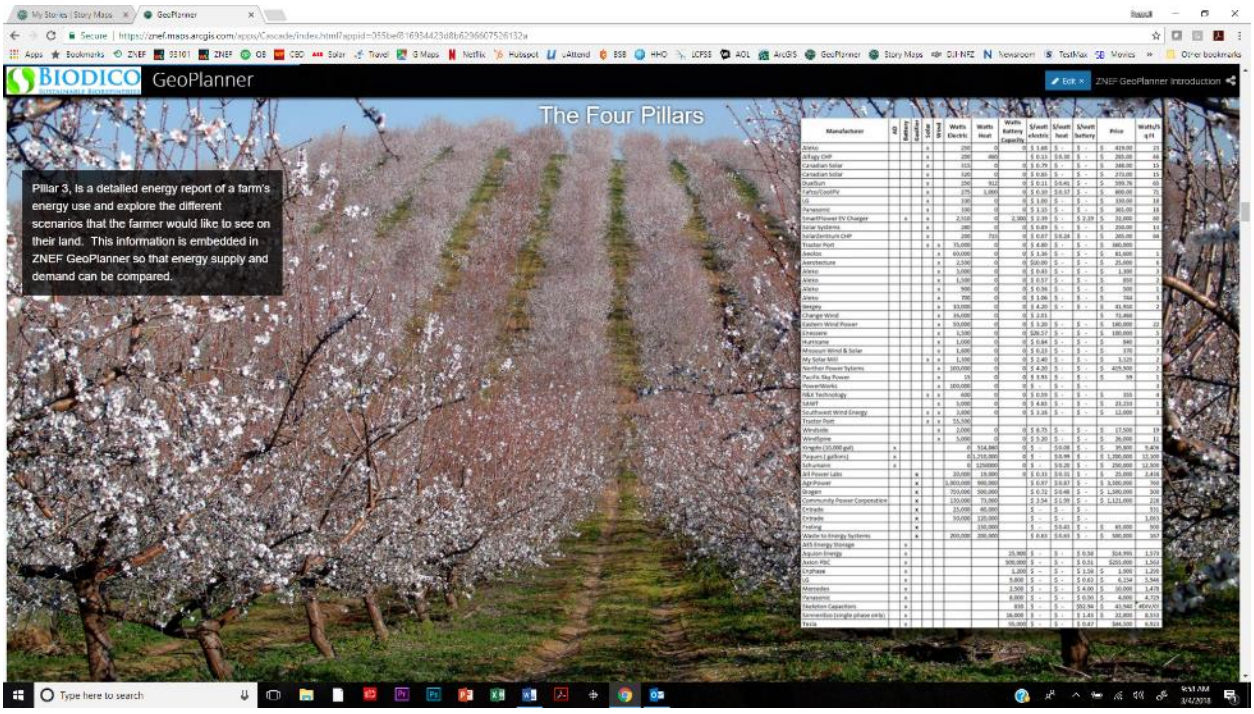
The four pillars of the ZNEF GeoPlanner.


BIODICO
GeoPlanner
The Four Pillars
Four pillars: resource assessment, agriculturally appropriate technology, energy supply and demand, economic optimization.
The first pillar is resource assessment using resource maps developed by NREL and others.
Direct Normal Solar Resource of California
NREL
Type here to search

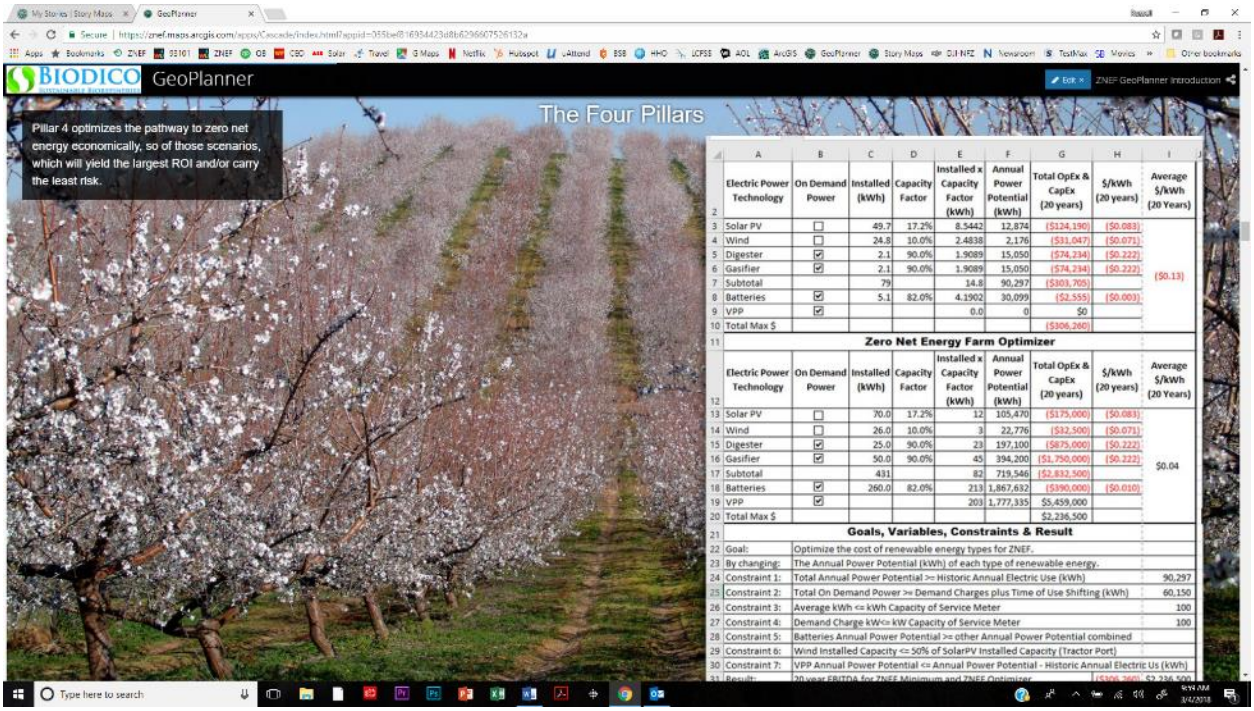
Pillar 2 of the ZNEF GeoPlanner



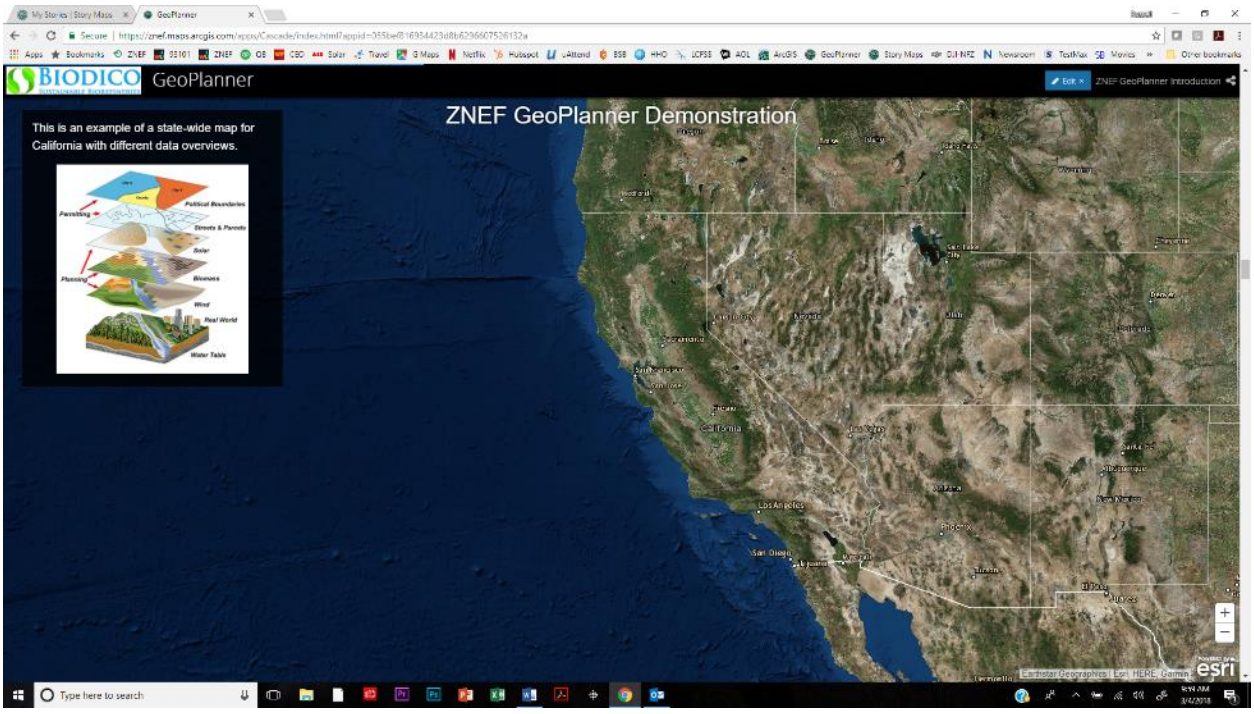
Pillar 3 of the ZNEF GeoPlanner



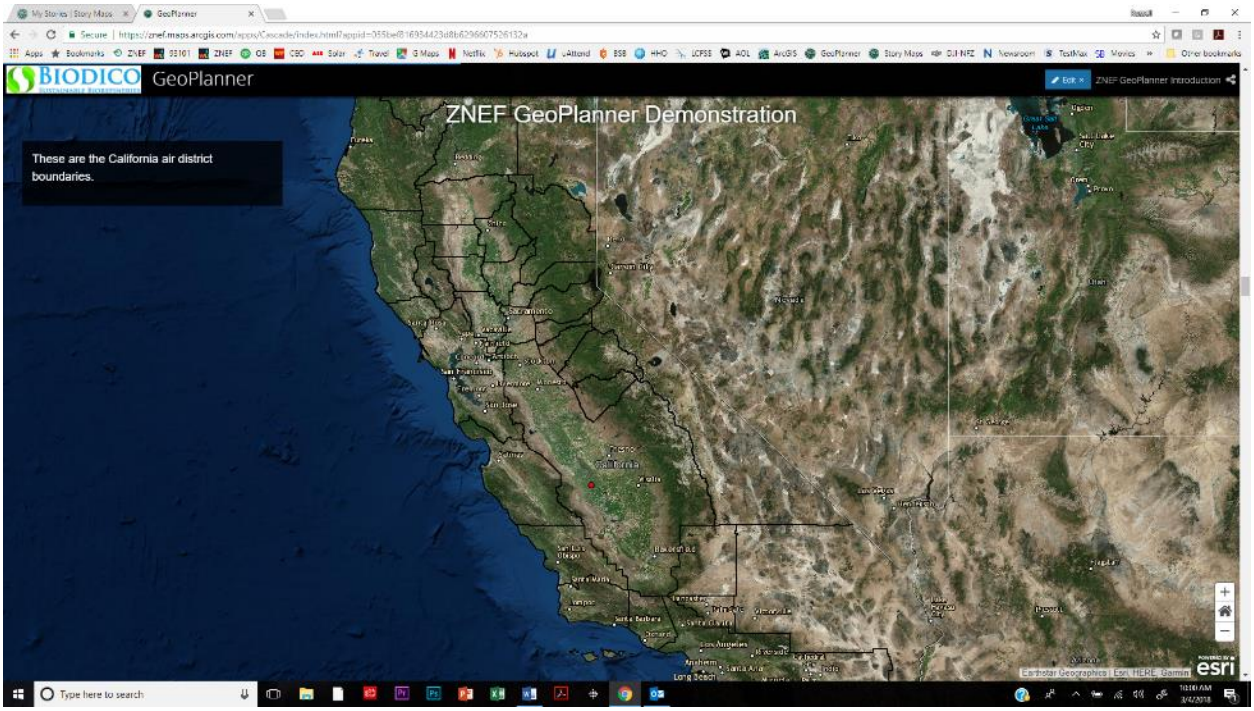
Pillar 4 of the ZNEF GeoPlanner



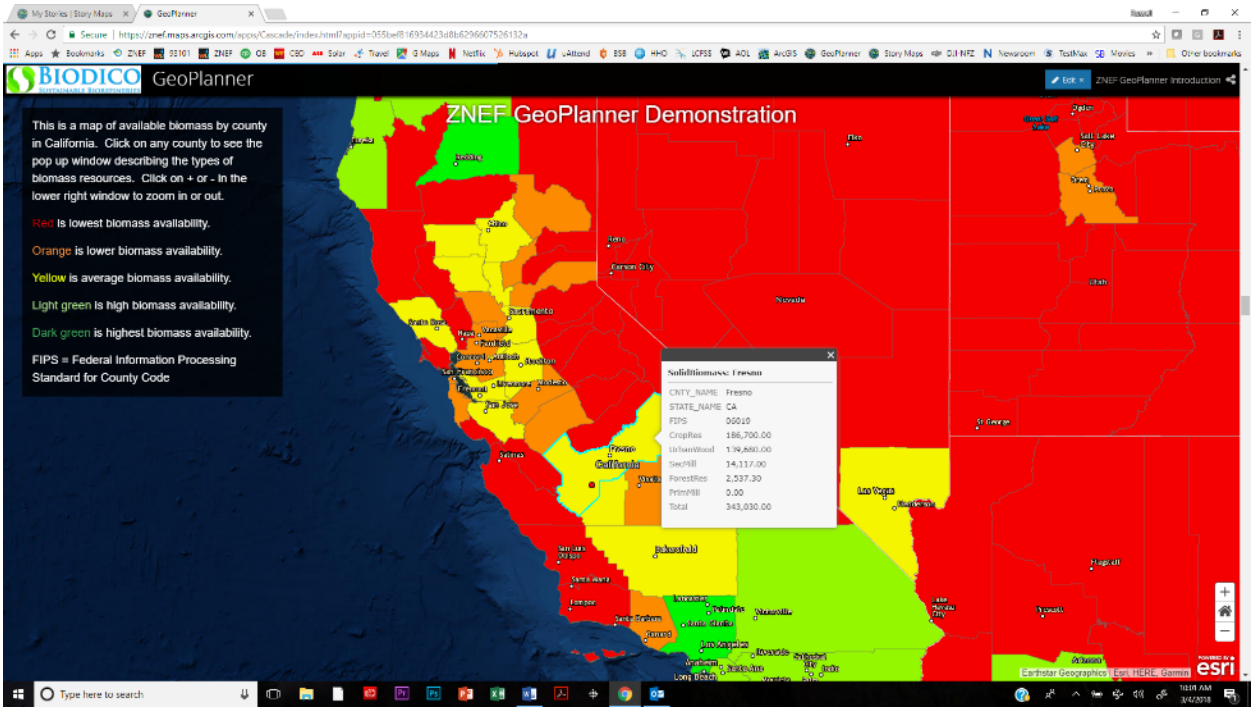
ZNEF GeoPlanner Demonstration



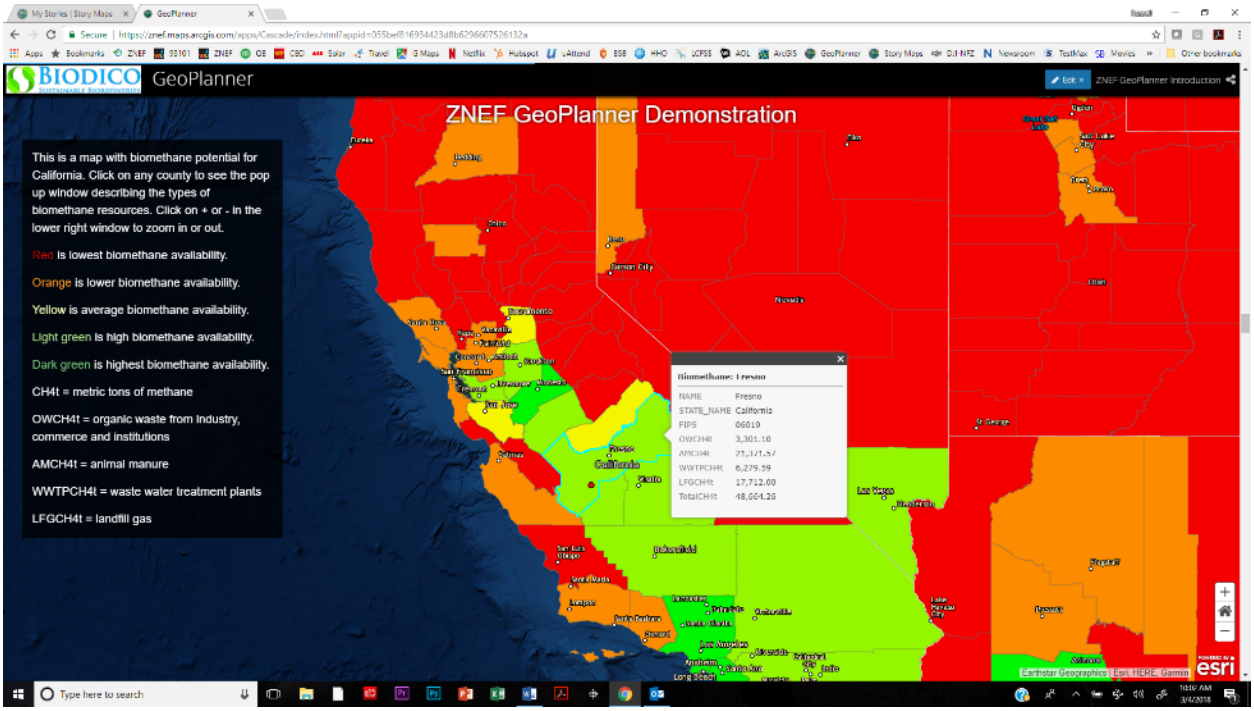
The Air Pollution Control Districts of California



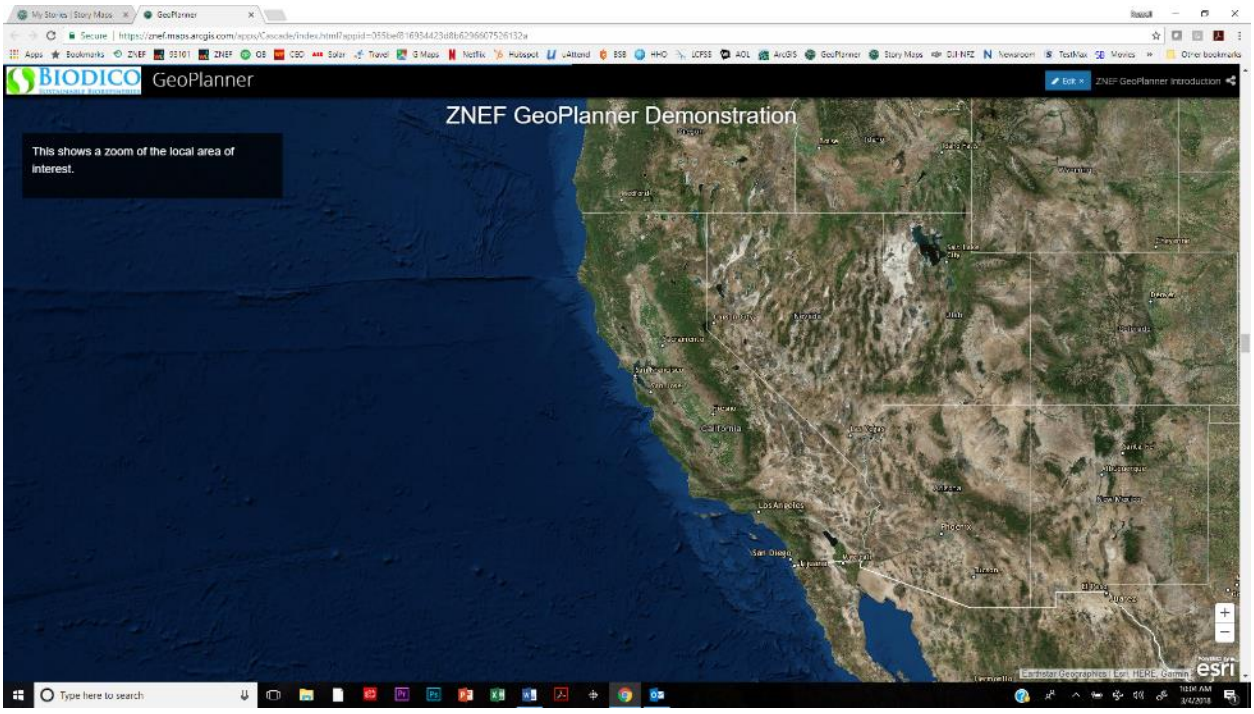
Biomass potential in California, with Fresno County as an example.



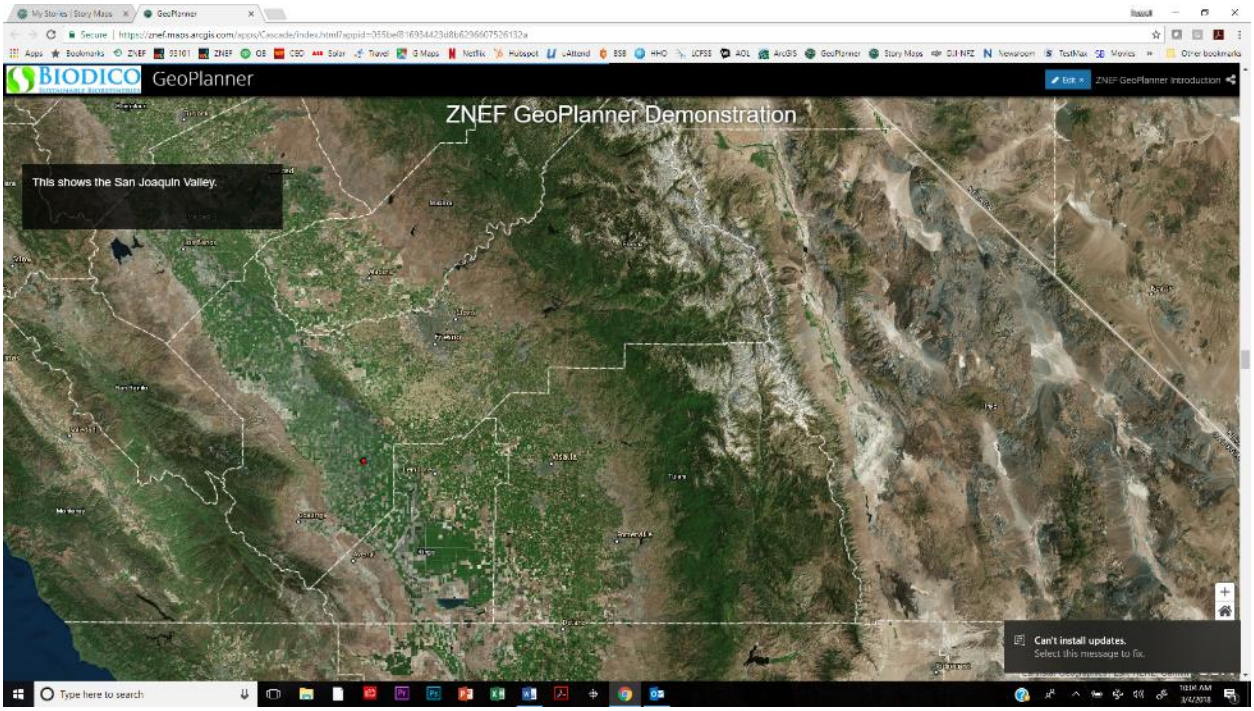
Biomethane potential in California, with Fresno County as an example.



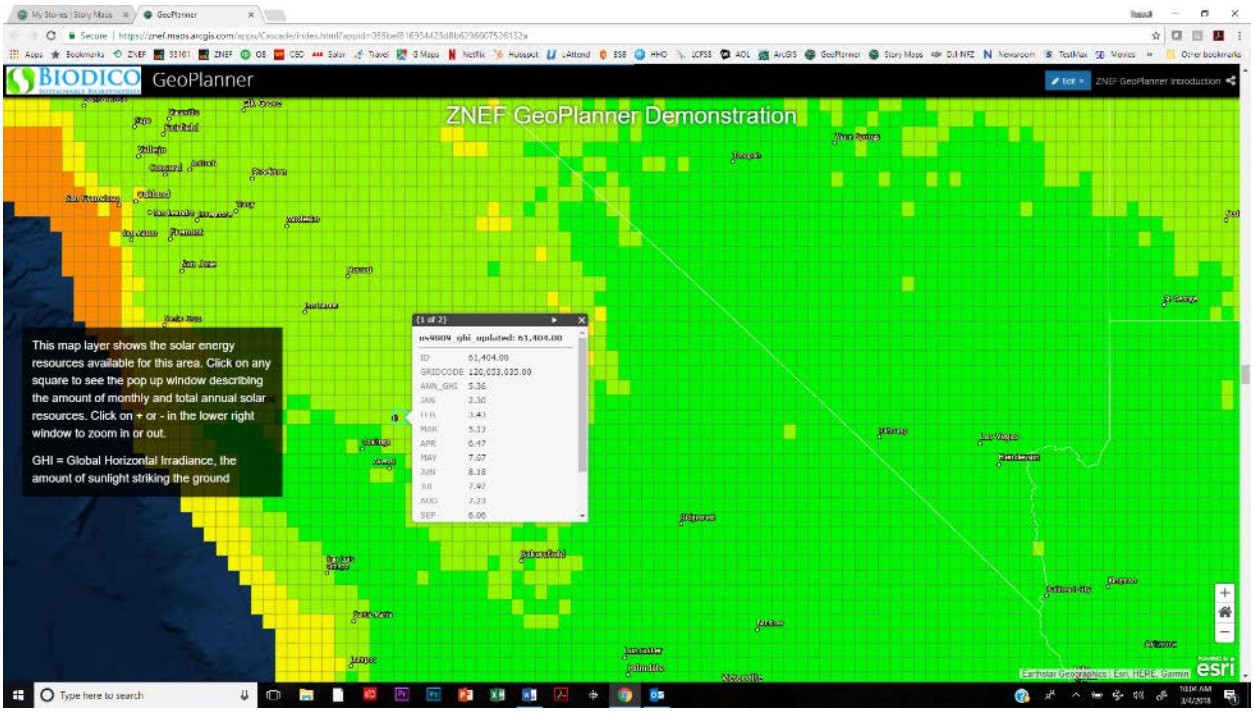
A zoomable overview of California is embedded in Story Map.



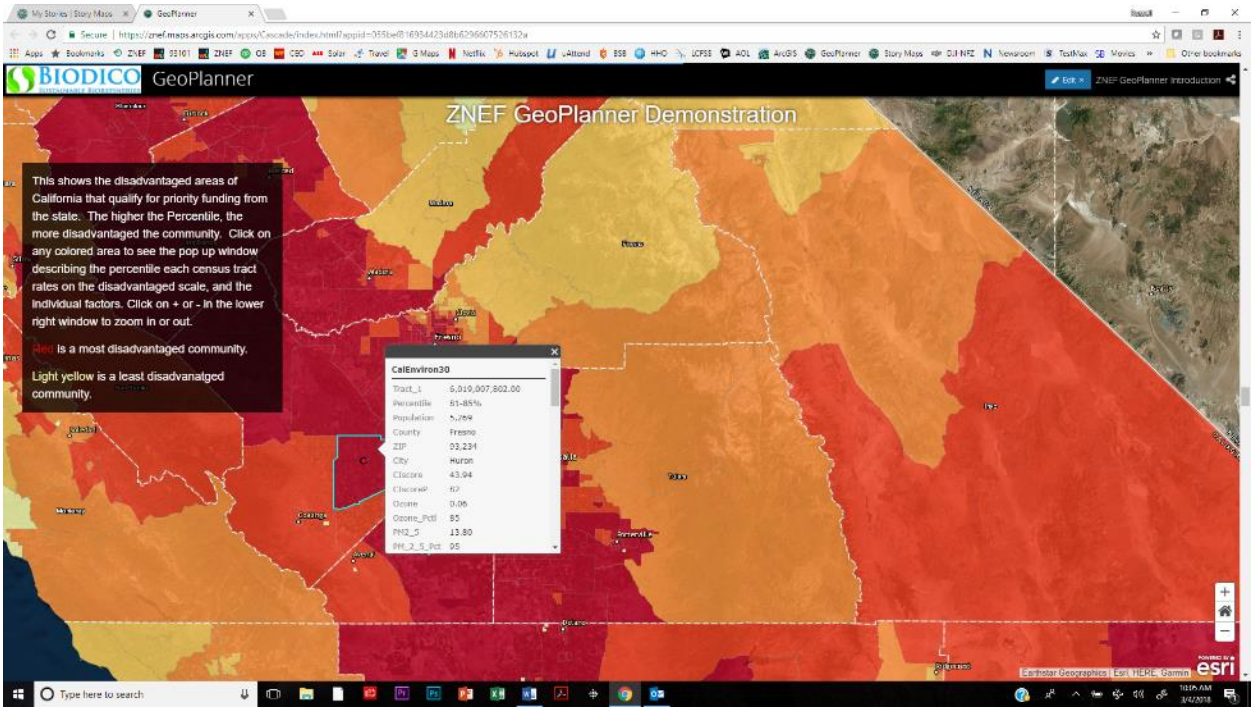
This is an example of zooming into the San Joaquin Valley.



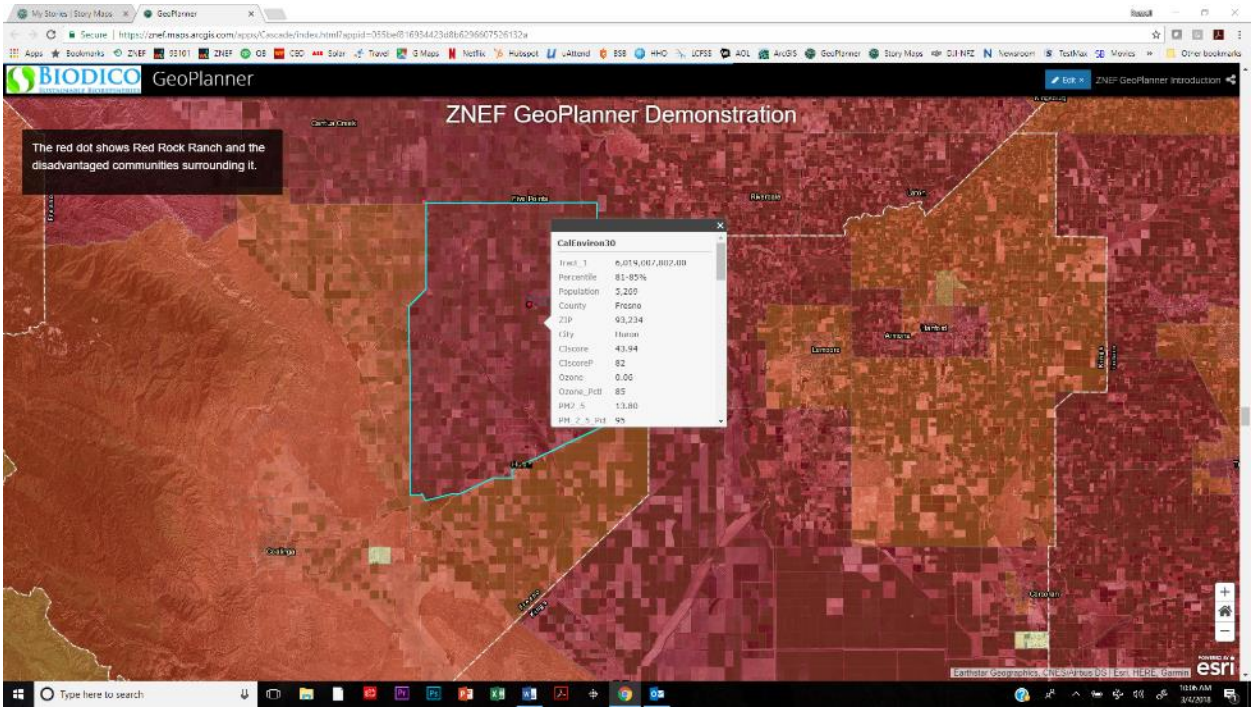
This is an example of a solar map with a detailed insert for the area of Red Rock Ranch.



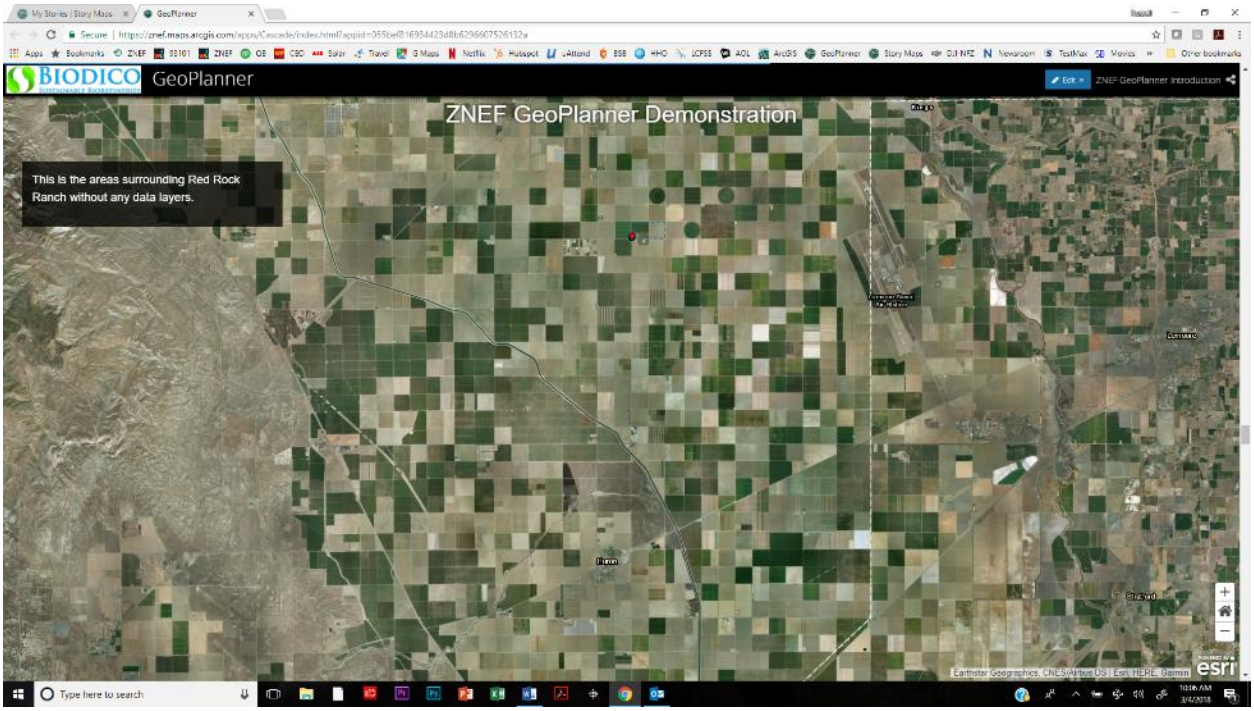
This map shows the disadvantaged areas of California that qualify for incentives.



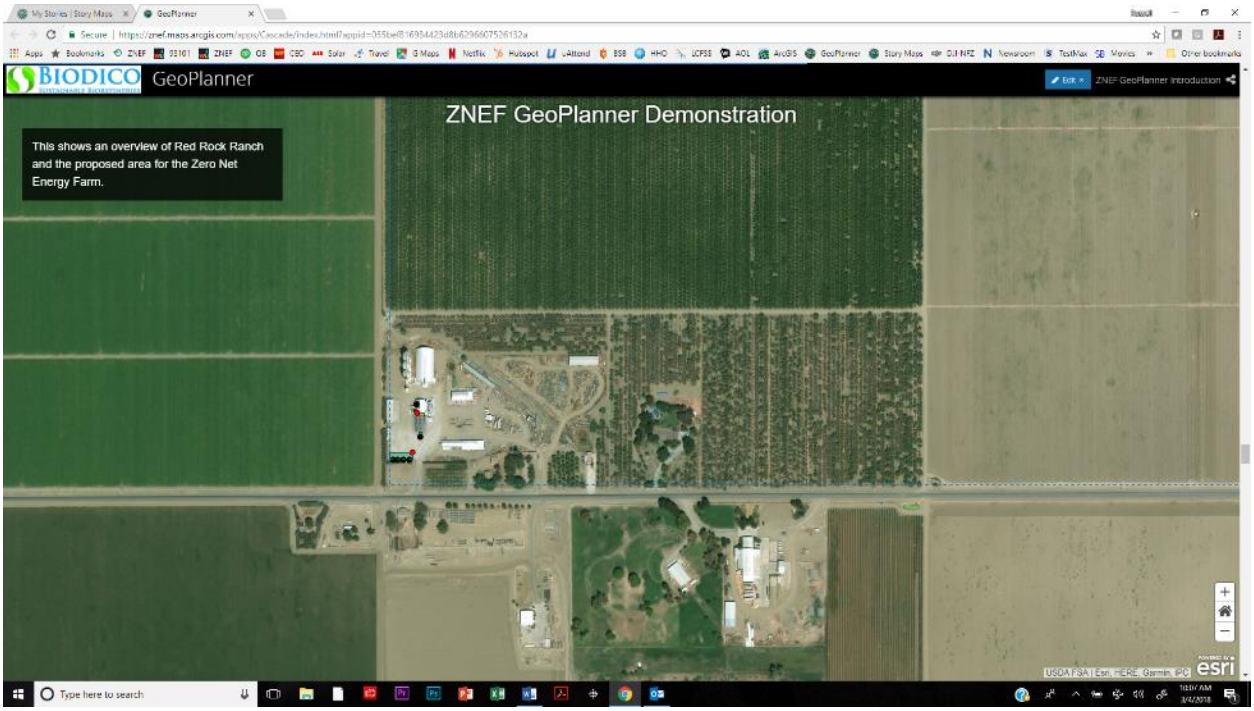
This map shows a detailed insert for the nature of the disadvantaged community at Red Rock Ranch.



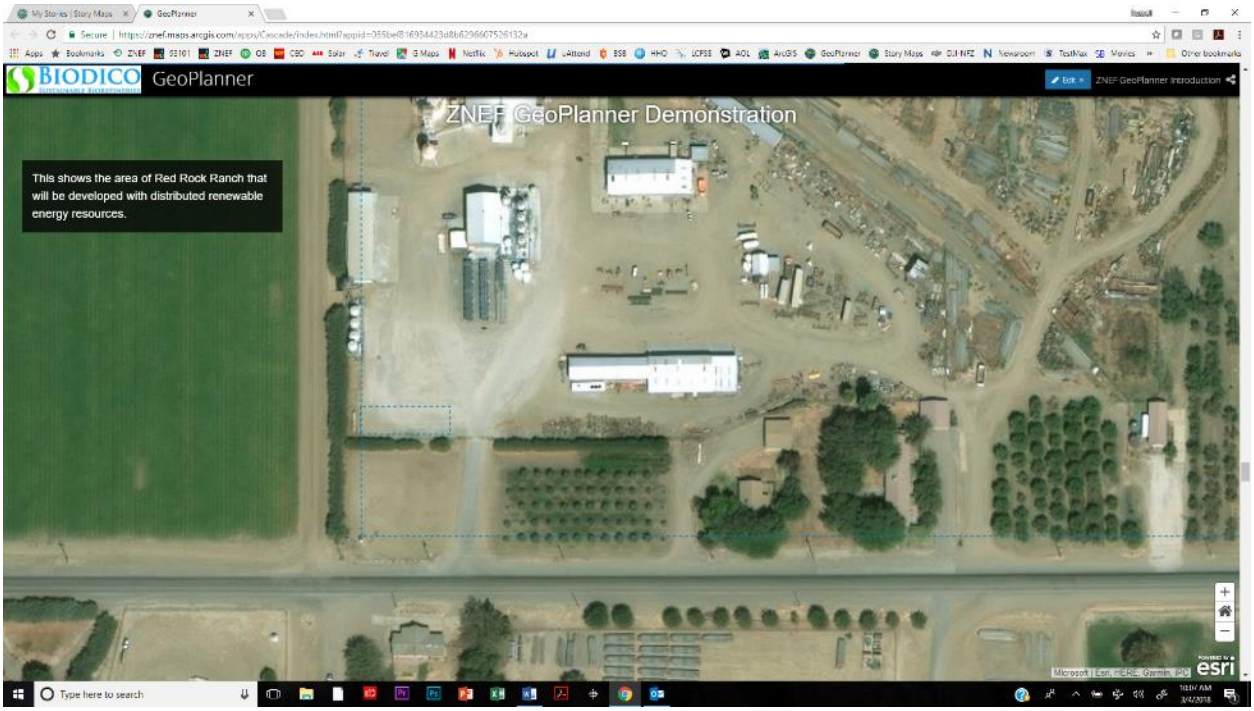
This map shows the area around Red Rock Ranch without any data layers.



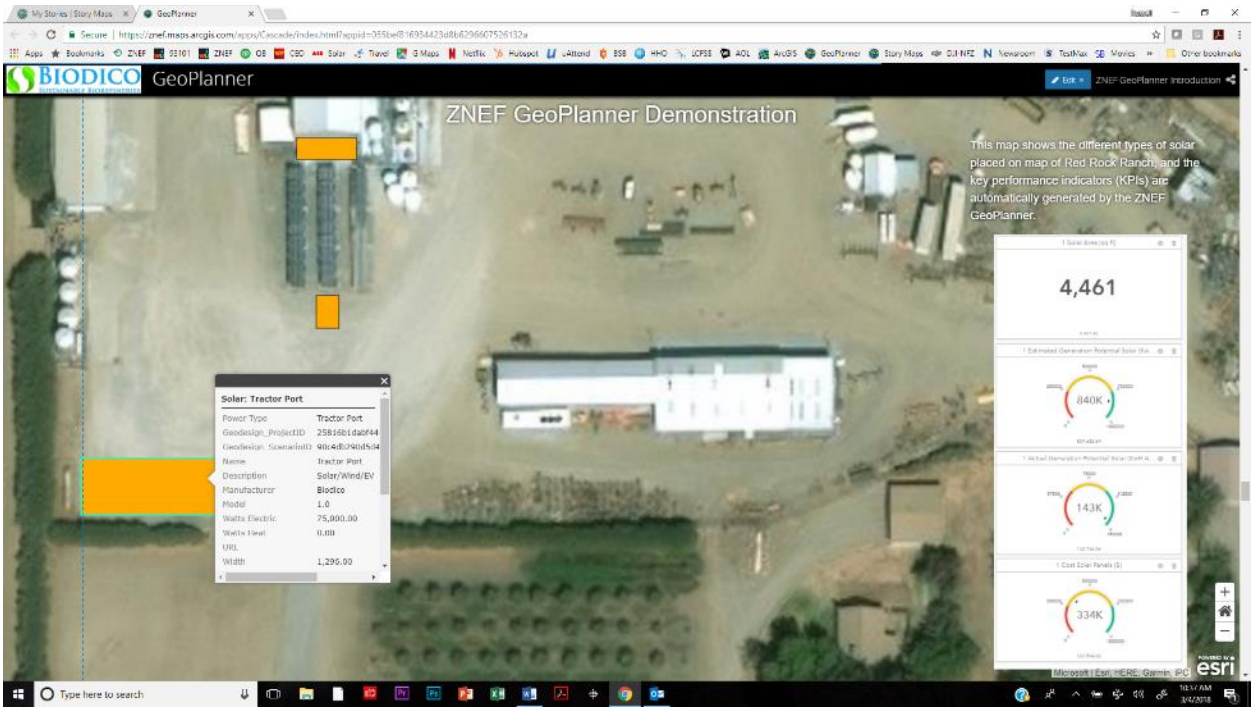
This map shows a closer view of the potential site at Red Rock Ranch for renewable energy technology.



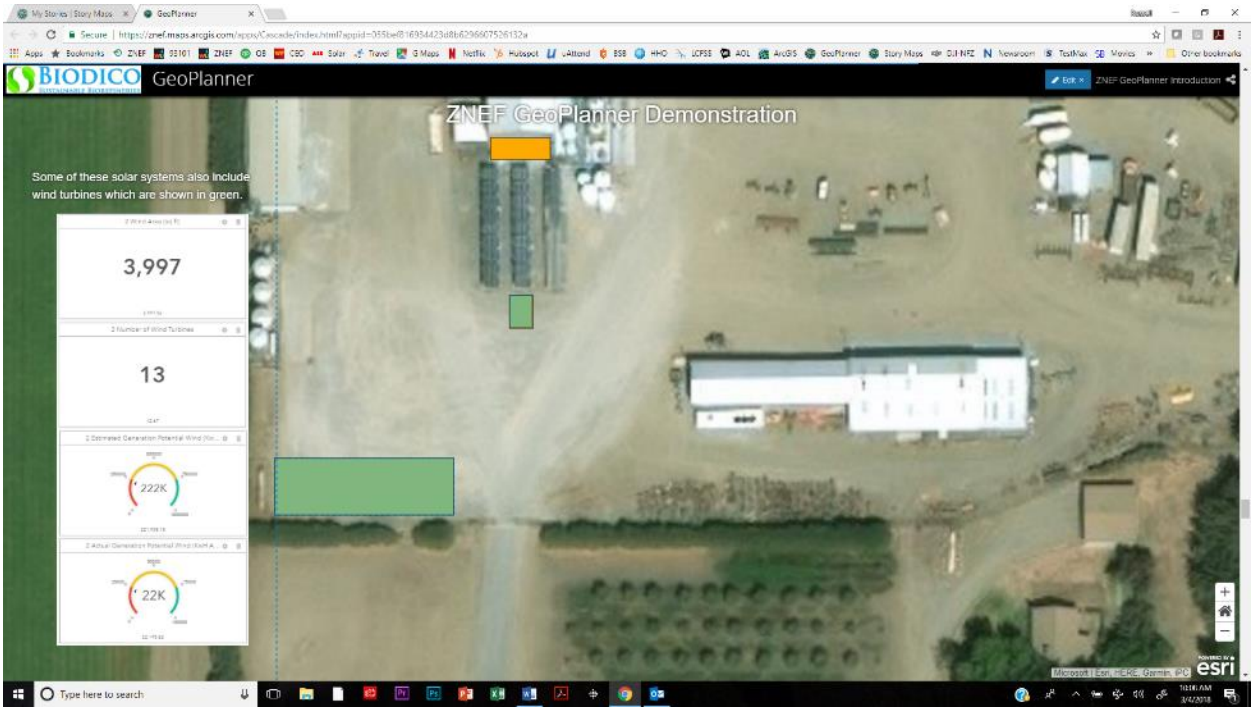
This map shows an even closer view.



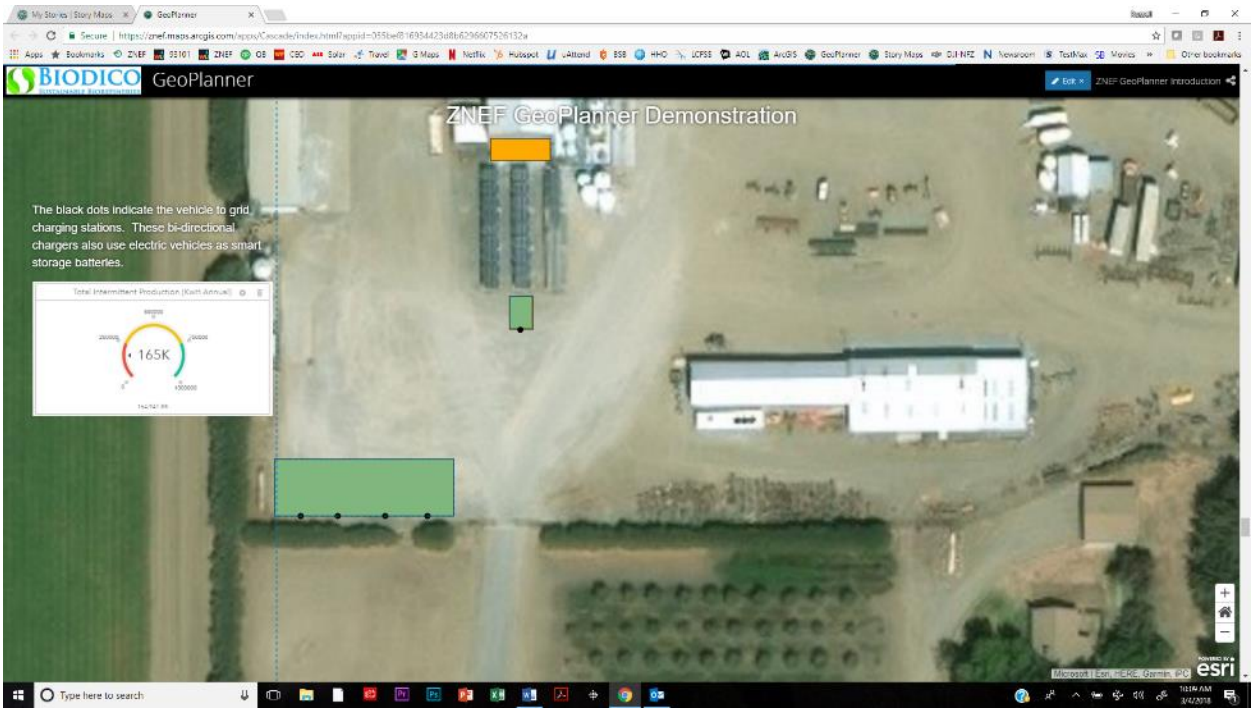
This shows the placement of three solar technologies (orange boxes). The left inset shows detail on the technology used in that area and the inset on the right shows a detailed analysis of the amount and type of power potential for all three technologies.



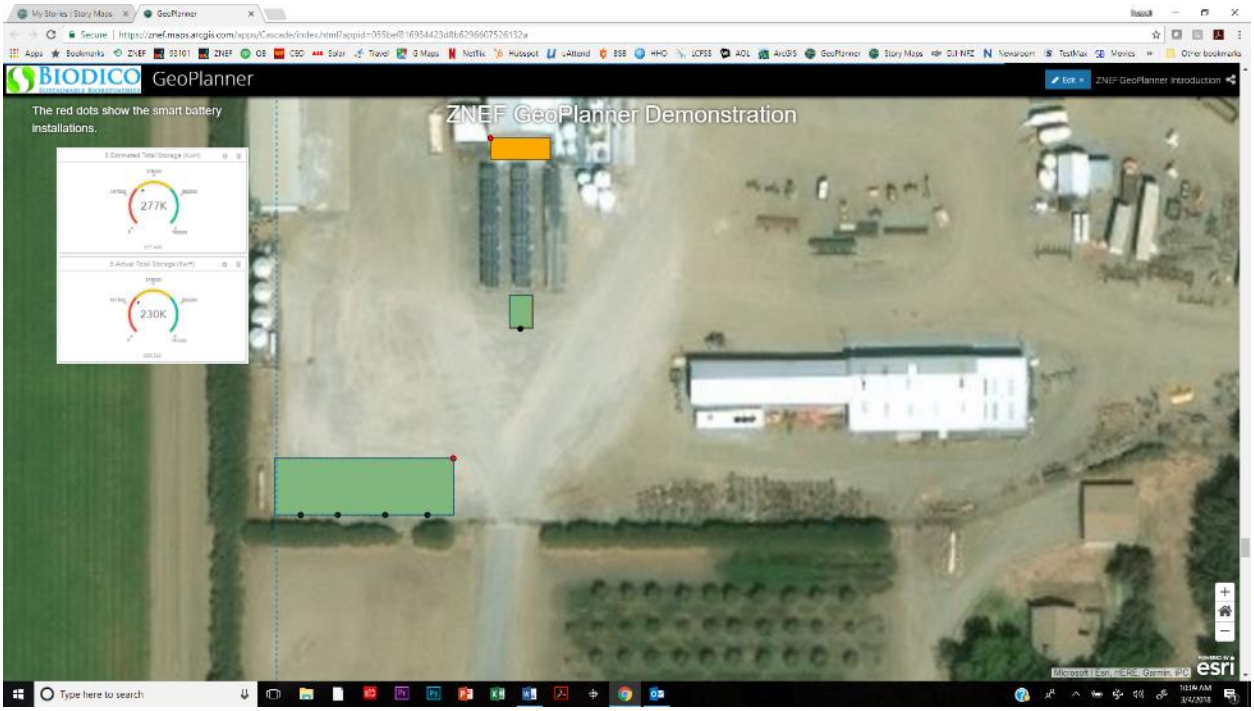
This shows the solar technologies that also use wind technology.



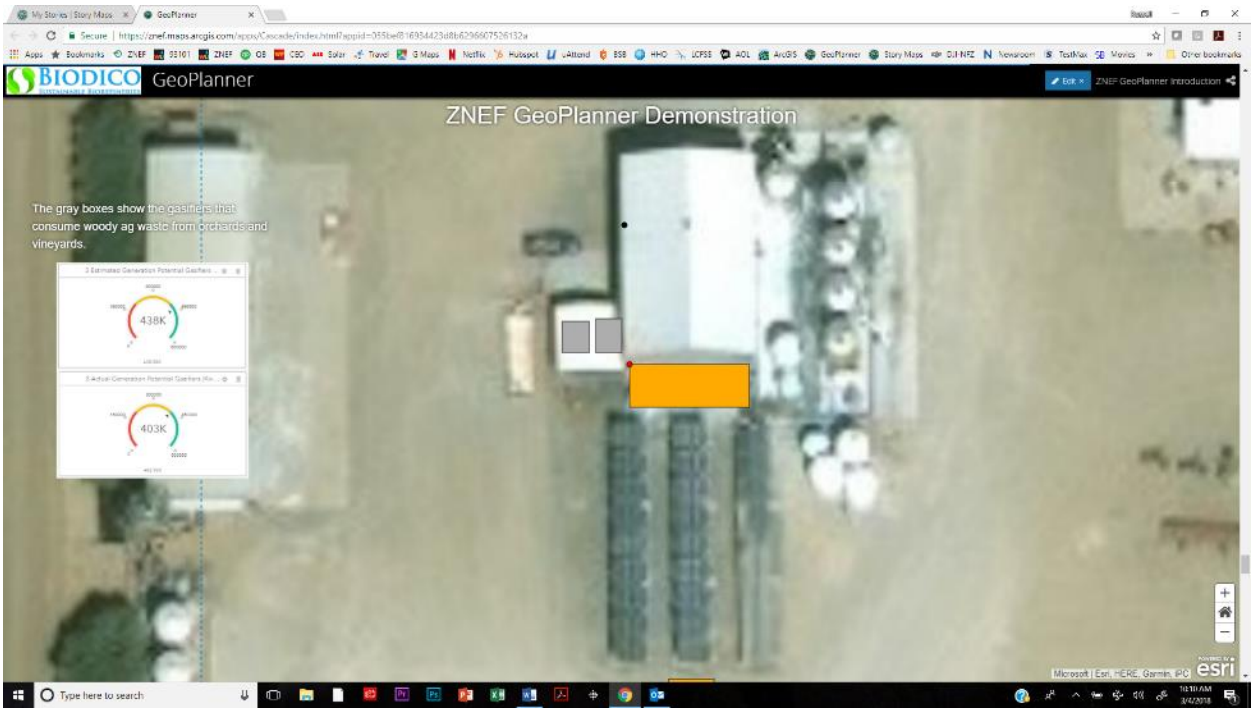
The black dots show the location of proposed electric vehicle charging stations.



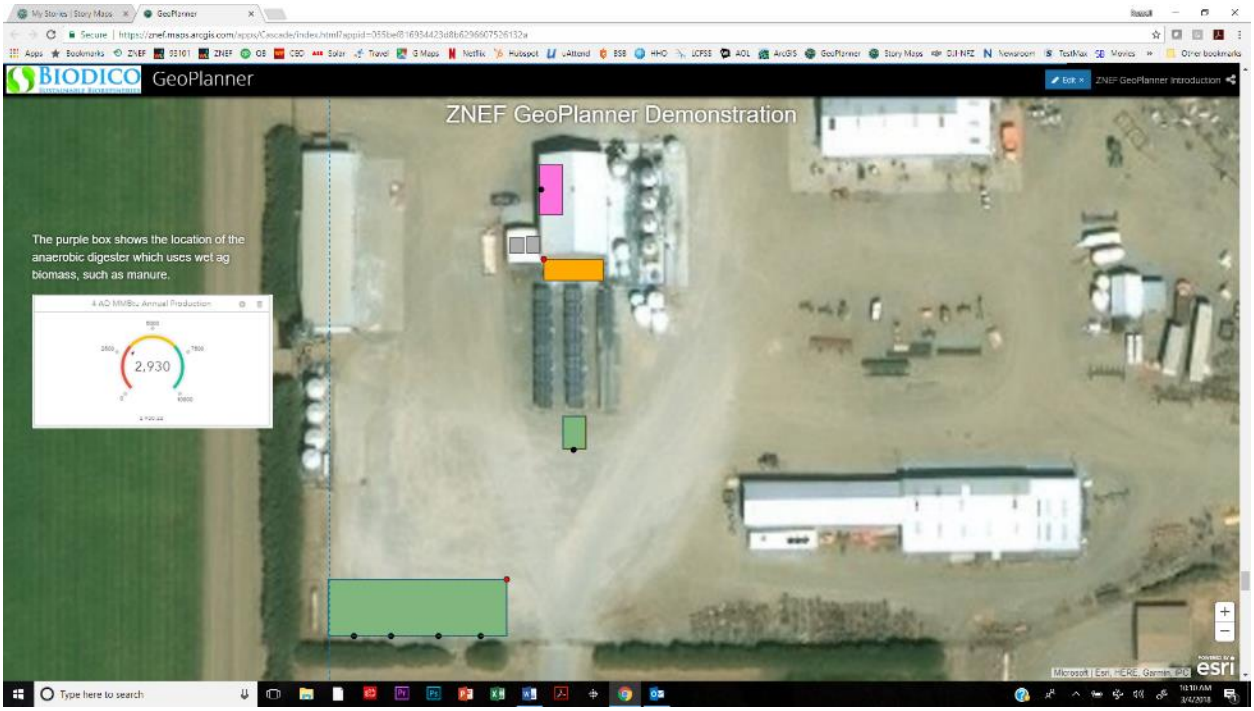
The red dots show the proposed locations for smart battery banks.



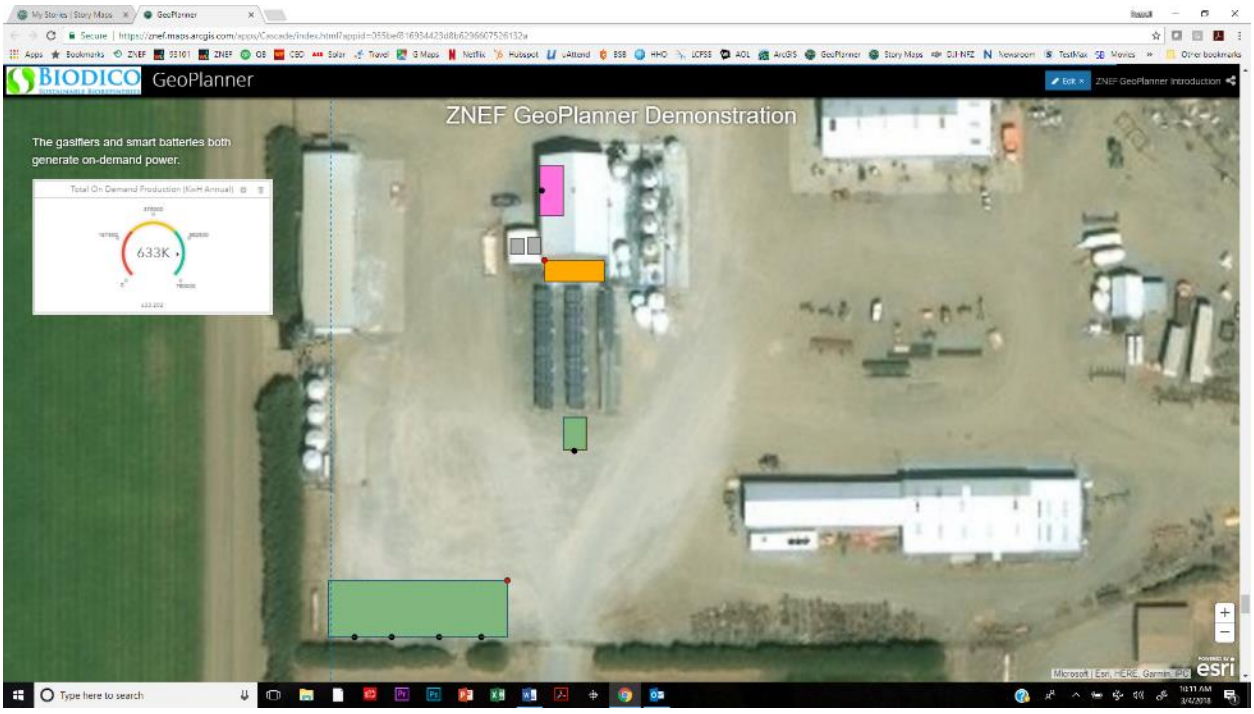
The grey boxes show the proposed location for two different types of gasifiers.



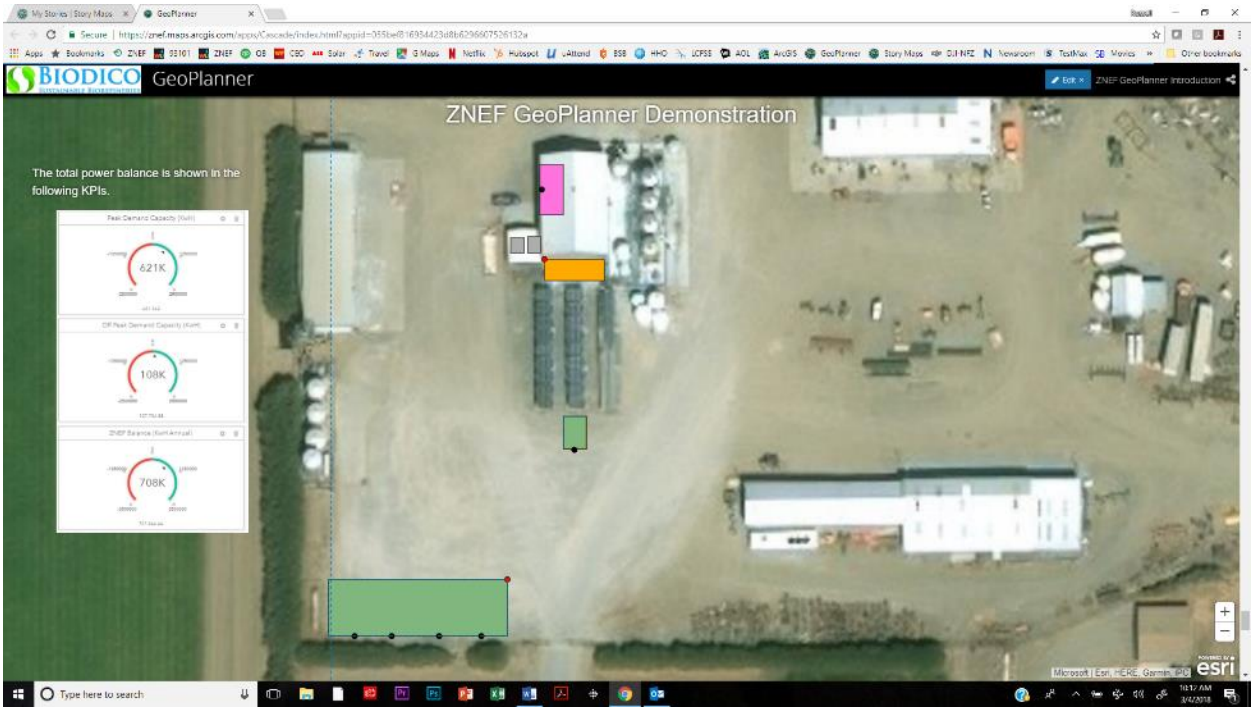
The purple box shows the location for an anaerobic digester.



This inset shows the amount of on-demand power.



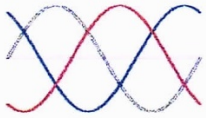
This inset shows the power balance for the entire proposed system.



This is the conclusion of the ZNEF Story Map.

APPENDIX R:
Technical Advisory Committee Comments

Larry Alberg Comments



Biodico Inc. 03-15-18

426 Donze Ave.

Santa Barbara, CA. 93101

Attn: Russ Teall

Subject: Zero Net Energy Farm Final Report

Russ,

After review of the final report as well as my notes and thoughts developed as part of the project thus far, I would like to offer comments below.

The overall premise as we progressed thru the project appears to be sound and from a mechanical and design view point the suggested items and components are certainly workable.

With over 2 years of hands on experience with the site and building the existing equipment it is my feeling that we can execute the next stages of the project without issue. The area lends itself well to fulfilling all the requirements laid out in the plan. We have done considerable work during this stage and I am confident that all the time and effort by all parties can be used going forward.

The report highlights many projects and leads us easily to the next steps. We are confident that all required and stated goals laid out can be met and look forward to our part in the project.

Larry Alberg

Fuel and Power Logistics, LLC lfalberg@att.net 661-578-0244

Dr. Stephen Kaffka Comments

Biodico's Zero Net Energy Farm Project: Energy Self-Sufficiency Using On-Site Renewable Resources in a Disadvantaged Community in the San Joaquin Valley

The objective of the Zero Net Energy Farm (ZNEF) is to create a Master Community Design (MCD) for a distributed renewable energy project in a disadvantaged agricultural community in the San Joaquin Valley.

Stephen Kaffka Comments[6]:

The ZNEF project has resulted in a thorough set of documents that review a wide range of alternative energy technologies relevant to rural communities in California, especially agricultural communities. The report and appendices can act as guides to other individuals and groups interested in developing local alternative energy systems. Biodico industries is an experienced bioenergy developer and deeply familiar with the statutes and regulations governing the development of alternative energy projects in California and elsewhere. They were well placed to review and select the critical types of information needed and processes and steps to follow to develop alternative energy-based systems in rural areas of California. The report includes a wide range of relevant information and website references that is impressive in its own right. In addition, Biodico has developed a GeoPlanner tool in cooperation with ESRI, Inc. that usefully assembles relevant alternative energy system potential in a geospatial format. This in itself was a worthy outcome of the project.

The technology review is useful but overlooks some related references created previously for CEC, especially with respect to (wrt) gasifiers and other thermochemical technology[7], and regional biomass supply assessment. The assembly of energy technology vendors into a database was helpful.

Having flow charts for the diverse permits needed for a project in California in one place was both helpful and amazing.

The appendices are useful technical references for technology featured in the report. All this information and related resources will be helpful to others.

The ZNEF has resulted in useful and general guidance reference and useful software to support the project's objectives, and is a successful effort on the part of the California Energy Commission and Biodico to promote additional projects and development in the state.

Specific comments:

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[6] Technical Advisory Committee member. Srkaffka@ucdavis.edu; 530-304-6603

[7] https://biomass.ucdavis.edu/wp-content/uploads/Task7-Report_Biomass-Gasification_DRAFT.pdf ; https://biomass.ucdavis.edu/wp-content/uploads/CA_Biomass_Resource_2013Data_CBC_Task3_DRAFT.pdf ; https://biomass.ucdavis.edu/wp-content/uploads/09-20-2013-2012-01-biomass-management-zones-and-new-pathways-to-bioenergy.pdf

This is not an issue for the report, but I don't believe NREL data in figure 5. More solar radiation along the central coast than in western Fresno County and Bakersfield?

Page 59. Have USDA and USDOE loan programs changed since the Trump Administration began?

Table 3, page 72. California irrigated and dry-farmed cropland is closer to 10M ac, not 25M ac. The additional land is low-management level rangeland, which is unsuitable for intensive agricultural production for the most part.

Chelsea Teall, PE Comments

3 Stewart Ct
Moraga, CA 94556
805.570.0827

March 18, 2018

Russell Teall, JD
President
Biodico, Inc.
426 Donze Ave.
Santa Barbara, CA 93101

Subject: Biodico's Zero Net Energy Farm, CEC Grant EPC-15-071, Comments on Final Report

Dear Mr. Teall:

I have reviewed Biodico's draft final report for the Zero Net Energy Farm (ZNEF) as a member of the technical committee for the California Energy Commission (CEC) Grant EPC-15-071. I would like to offer the following comments for Biodico's consideration.

The primary goal of the ZNEF is to provide energy self-sufficiency using on-site renewable resources in a disadvantaged community in the San Joaquin Valley. The draft final report clearly lays out a viable approach for accomplishing this goal using an innovative combination of complimentary renewable energy sources. In addition to creating renewable energy from the sun and wind, ZNEFs could generate energy from agricultural waste products using anaerobic digesters and gasifiers. Solar PV, solar thermal, wind turbines, anaerobic digesters, and gasifiers are proven and sound technologies; however, their adaptation and combination to meet agricultural energy demands and waste sequestration is novel.

From an engineering perspective, the systems described in the Master Community Design for Red Rock Ranch are viable, but the difficult part will be integrating them and responding to automated dispatch requests from the California Independent Systems Operator or PG&E.

An important aspect of the ZNEF are the tools developed by Biodico's team to ease adoption of renewable energy by farms in California. The GIS project management application could easily determine the economic feasibility of different renewable energy permutations on farms across California. Making renewable energy assessments easy will proliferate adoption.

I have enjoyed my involvement in this project and look forward to working with you in the future. I would like to thank you for the opportunity to serve on the technical advisory committee for this progressive project.

Sincerely,

Chelsea Teall

Chelsea Teall, P.E.
Engineering Consultant

Leon Woods III Comments

Biodico's 'Zero Net Energy Farm' (ZNEF) project, was and is a very exciting and socially beneficial project with great potential for statewide implementation. Not only does it provide the ability for a farmer to lower their 'greenhouse gas footprint', but in doing so allows them to become energy self-sufficient using on-site renewable resources.

The feedback to the ZNEF project from a myriad of policy and industry leaders has been significant. They have asked the ZNEF project team to keep them updated and have lent their support whenever needed. This has been reflected after presentations to the Chairman of the CA Food and Agriculture Board and the full board itself at the 2017 World AG Expo in Tulare, California.

The interest in the ZNEF project has been equally impressive with selected state legislators and local governmental officials. They have requested information and have even participated in ZNEF project 'outreach efforts'. Their interest obvious due to the value it provides their farming constituents in and around disadvantaged communities.

For a sustained effort to continue the effort for the foundation the ZNEF project has laid, there are factors that should be considered. First, relative to a marketing program, it is important for the major farm organizations (e.g. Western Growers and the CA Farm Bureau), understand and embrace the ZNEF concept. Not only could they be invaluable in the marketing of this concept to their members, they could also advocate for this concept before the CA legislature the CA Public Utilities Commission (CPUC) Where a commercial ZNEF entity could assist farmers with an awareness of the resource assessment and applicable renewable technology options, the major farm organizations could advocate before the legislature, local governments and CPUC, streamlining the permitting process and making net-metering regulations friendlier and less onerous.

Without question, it has been a privilege to participate in, and to work with Biodico's ZNEF project team. Not only will a sustained ZNEF project bring much needed value to CA's disadvantaged communities for a source of economic development, it will assist CA agriculture in a time of increased global competition.